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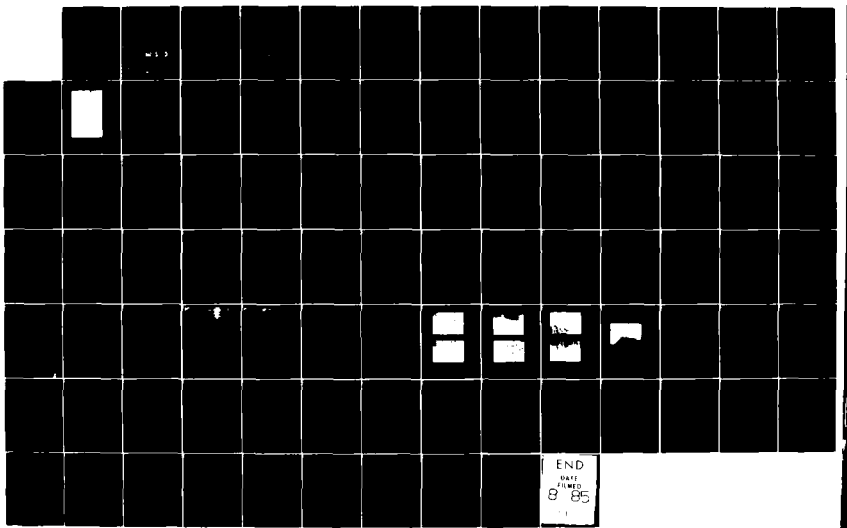

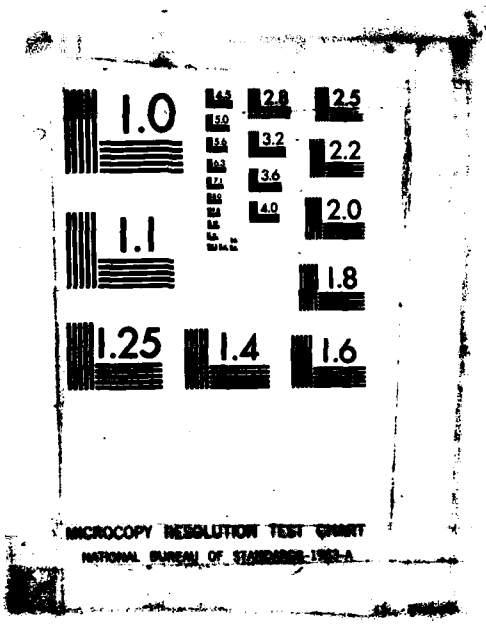
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MASSACHUSETTS COASTAL BASIN

UXBRIDGE, MASSACHUSETTS

LEE POND DAM

MA 00891

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JULY 1981

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER MA 00891	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Lee Pond Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE July 1981 13. NUMBER OF PAGES 60
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Massachusetts Coastal Basin
Uxbridge, Massachusetts
Emerson Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam consists of an earthen embankment with a natural spillway and a vertical stone masonry wall along two short sections of the downstream face. The embankment has a minimum top width of 15 ft. and a maximum height of 25 ft. The dam is considered to be in poor condition.Features that could effect the structural integrity of the dam are seepage at the downstream toe of the dam, erosion and slumping of the dam slopes, among other:

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED

AUG 21 1981

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Inclosed is a copy of the Lee Pond Dam (MA-00891) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is vitally important.

Copies of this report have been forwarded to the Department of Environmental Quality Engineering, and to the owners, Mr. & Mrs. William Mahlerwein and Mr. & Mrs. J. Carlos Maciel. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Environmental Quality Engineering for your cooperation in this program.

Sincerely,

WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Acting Commander and Acting Division Engineer

Incl
as stated

LEE POND DAM

MA 00891

MASSACHUSETTS COASTAL BASIN

UXBRIDGE, MASSACHUSETTS

PHASE 1 INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE 1 INSPECTION REPORT

IDENTIFICATION NO.:		MA 00891
NAME OF DAM	:	LEE POND DAM
TOWN	:	UXBRIDGE
COUNTY AND STATE	:	WORCESTER, MASSACHUSETTS
STREAM	:	EMERSON BROOK
DATE OF INSPECTION:		DECEMBER 11 & 22, 1980

BRIEF ASSESSMENT

The Lee Pond Dam consists of an earthen embankment with a natural spillway and a vertical stone masonry wall along two short sections of the downsteam face. The embankment has a minimum top width of 15 ft. and a maximum height of 25 ft. The overall length of the dam is 870 ft., including the natural spillway at the right end of the dam which is about 15 ft. wide at normal pool elevation. The outlet works consist of an inoperable sluice gate located about 250 ft. from the left end of the dam. The dam impounds Lee Pond, which is used for recreational purposes. Maximum storage capacity at the top of dam is 220 acre-feet.

Based on visual inspection and a review of all available pertinent data, the dam is considered to be in poor condition.

Features that could effect the structural integrity of the dam are seepage at the downstream toe of the dam, erosion and slumping of dam slopes, extensive tree growth on the dam slopes and animal burrows on the crest and downstream face.

Based on the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, the dam is classified as "Small" in size, with a "Significant" hazard potential. A Test Flood which approximated the 100 year Flood was selected in accordance with the Corps of Engineers' guidelines. The calculated test flood inflow of about 660 cfs results in a routed outflow of about 650 cfs. The spillway passes 100% of the test flood outflow with a freeboard of about 3 ft.

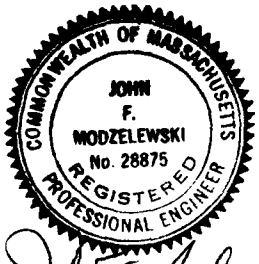
Recommendations include that the owner engage the services of a qualified registered engineer to specify and oversee the removal of trees and root systems on the embankment, investigate the cause of wet areas at the toe of the dam embankment and design, oversee construction of erosion protection for the upstream face and crest of the dam, and provide a means to lower the reservoir level in case of an emergency.

Technical inspections by a qualified, registered engineer should be performed every year, monthly visual inspections should be performed by the owners' personnel. A formal downstream warning

system should be put into effect.

The owner should implement the recommendations and remedial measures as described herein and in greater detail in Section 7 of this Report within 1 year after receipt of this Phase 1 Inspection Report.

ASEC CORPORATION



John F. Modzelewski P.E.
Project Engineer/
Director of Engineering Services

This Phase I Inspection Report on Lee Pond Dam (MA-00891) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JOSEPH W. FINEGAN, JR., CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase 1 Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase 1 Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspection. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase 1 investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect

to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase 1 inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase 1 Investigation does <u>not</u> include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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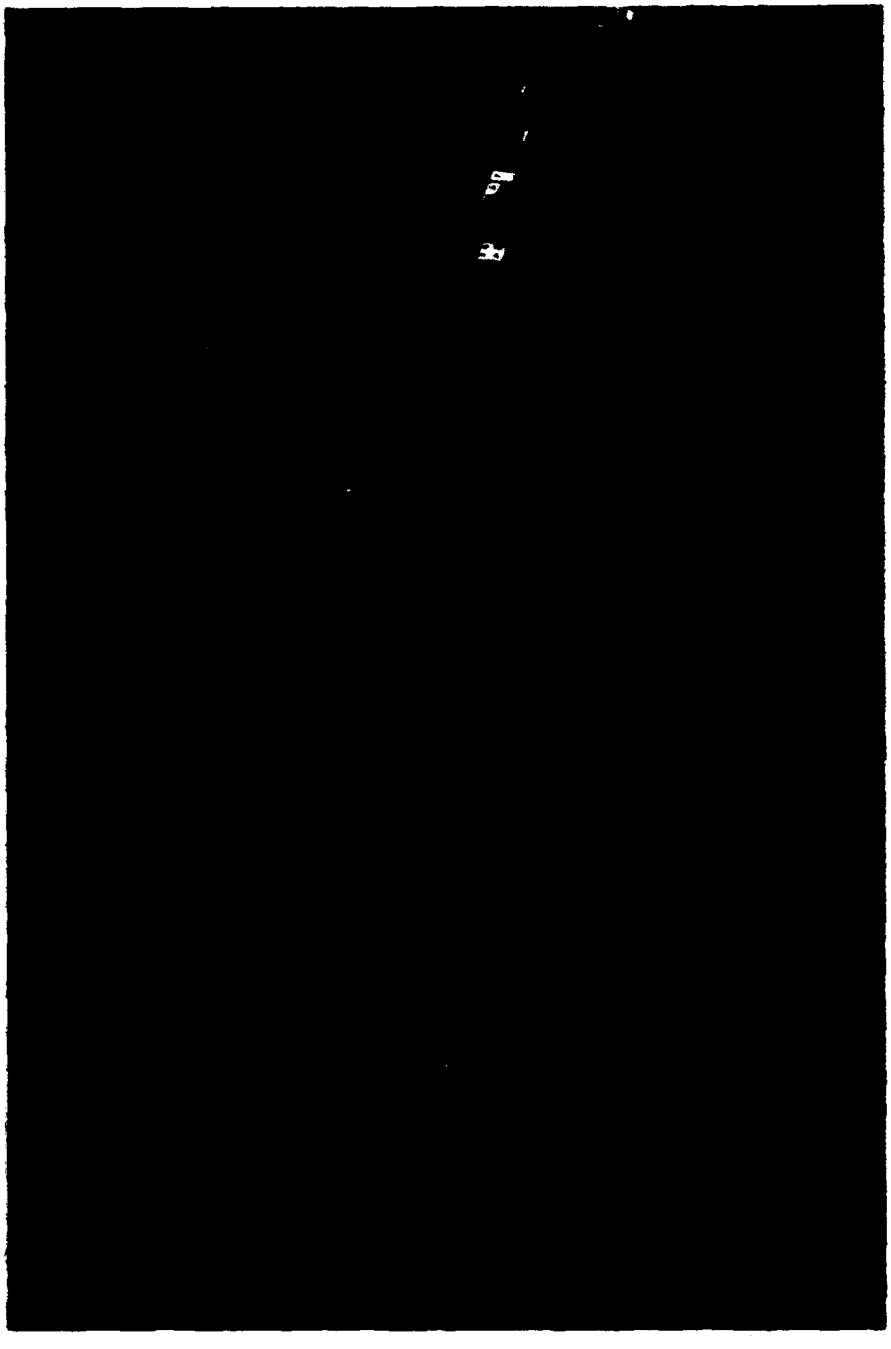
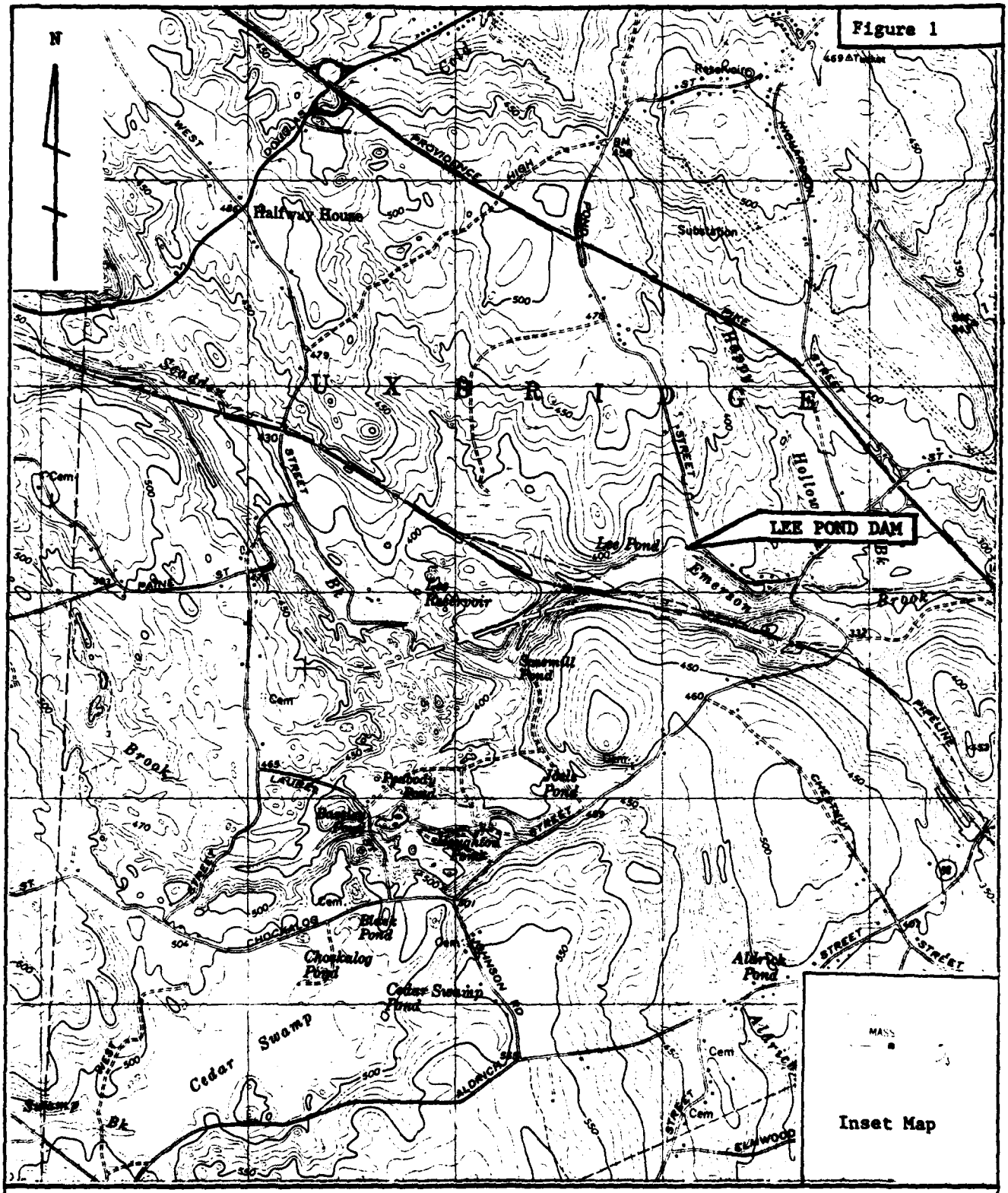


Overview Photo

U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS ASEC CORP. CONSULTING ENGINEERS BOSTON, MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	LEE POND DAM TR. TO EMERSON BROOK UXBRIDGE, MASS. MA 00891 DECEMBER 10, 1980

Figure 1



LOCATION PLAN

LEE POND DAM
UXBRIDGE, MASSACHUSETTS

SCALE: 1 : 25 000

ASEC CORPORATION UXBRIDGE QUADRANGLE 1979

NATIONAL DAM INSPECTION PROGRAM

PHASE 1 INSPECTION REPORT

PROJECT INFORMATION

SECTION 1

1.1 GENERAL

a. AUTHORITY

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. ASEC Corporation has been retained by the New England Division to inspect and report on selected dams in the state of Massachusetts. Authorization and notice to proceed were issued to ASEC Corporation under a letter of December 8, 1980, from William E. Hodgson, Colonel, Corps of Engineers. Contract No. DACW33-81-C-0023 has been assigned by the Corps of Engineers for this work.

b. PURPOSE OF INSPECTION

The purposes of the program are to:

I. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interests.

II. Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dams.

III. To update, verify and complete the National Inventory of Dams.

1.2 DESCRIPTION OF PROJECT

a. LOCATION

The dam, which impounds Lee Pond, is located on Emerson Brook in Uxbridge, Massachusetts approximately one mile upstream of the Route 146 bridge crossing of Emerson Brook and two miles upstream of the confluence with the Blackstone River. The dam is shown on the Uxbridge Quadrangle Map having coordinates latitude 42°-02.8' and longitude 71°-38.6' (See Figure 1).

b. DESCRIPTION OF DAM AND APPURTENANT STRUCTURES

The dam is an earthen embankment with a natural spillway and a vertical stone masonry wall along two short sections of the downsteam face. The earth slopes of the dam are approximately 2H : 1V on the upstream slope and vary from 1H : 1V to 2H : 1V on the downstream slopes. The embankment has a maximum height of 25 ft. The top width of the crest varies to a minimum width of 15 ft. The overall length of the dam is 870 ft. Discharge at the dam site is through a natural stream channel outlet of variable cross section at the right end of the dam. This channel is about 15 ft. wide at normal pool elevation. There is also a 3 ft. x 3 ft. sluice gate at the mill site located about 250 ft. from the left end of the dam, however this gate is closed and inoperable. The outlet for this gate is a stone conduit which passes under the mill building. A sketch plan of the dam is included in Appendix B page B - 1.

c. SIZE CLASSIFICATION - "Small"

According to the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, a dam is classified as "Small" in size if the height is between 25 and 40 feet, or the dam impounds between 50 and 1000 acre-feet. The dam has a maximum height of approximately 25 ft. and a maximum storage capacity of 216 acre-feet. Therefore the dam is classified as small in size based on storage capacity and size.

d. HAZARD CLASSIFICATION - "Significant"

Based on the Corps of Engineers' Recommended Guidelines for the Safety Inspection of Dams, the Hazard Classification for the dam is "Significant". The dam is classified as a "Significant" Hazard Potential structure because it is located in a predominantly rural area where failure may damage the mill building on the downstream slope of the dam, a structure which appears to be inhabited on a seasonal basis. See Appendix D for failure analysis.

e. OWNERSHIP

Former Owner : Vasil & Bessie Cristo

Present Owner : William & Faith Mahlerwein
& J. Carlos & Lynn Maciel
P.O. Box 89
Pond Street
Uxbridge, MA 01569
(401) 762-1800 (Rhode Island Office)

f. OPERATOR Same as above

However dam is not operated

g. PURPOSE OF DAM

The dam impounds Lee Pond which is presently used exclusively by the owners for recreational purposes.

h. DESIGN AND CONSTRUCTION HISTORY

The precise history of this dam is unknown, but it apparently was constructed in the nineteenth century for the purposes of providing water power for a textile mill. Design plans for the original dam are not known to exist. No "As-built Plans" or other construction data are known to exist. A tracing of an undated plan entitled "Lee Dam 2 of 4" was found at the Worcester County Engineers office. According to the tracing, the plan was approved by the county commissioners in 1880. Other county records indicate that a dam existed on the site prior to 1858. Records at the county commissioners office indicate David M. Lee to be the designer and 1880 as the year of construction.

i. NORMAL OPERATIONAL PROCEDURES

There are no operating procedures at the dam, since there are presently no operable mechanisms. The sluice gate lifting mechanism has been dismantled to prevent vandals from operating the gate.

1.3 PERTINENT DATA

a. DRAINAGE AREA

The drainage area above the dam is about 5.6 square miles ranging in elevation from 340 ft.± to 630 ft.± NGVD. The watershed is characterized as sparsely settled land, mostly wooded, with numerous swamps and ponds throughout the watershed. Sawmill Pond, just upstream of Lee Pond, is formed at the confluence of the two major streams draining the watershed, Scadden Brook and Laurel Brook.

b. DISCHARGE AT DAMSITE

The discharge at the dam site is through a natural stream channel outlet at the right end of the dam. There is also a sluice gate at the mill site near the left end of the structure, however this gate is closed and inoperable.

NGVD = National Geodetic Vertical Datum

1.	Outlet Works (conduit) Size:	Inoperable Sluice Gate
2.	Maximum Known Flood at Damsite:	Unknown
3.	Ungated Spillway Capacity at Top of Dam Elevation:	3400 cfs 348.0 ft. NGVD
4.	Ungated Spillway Capacity at Test Flood Elevation Elevation:	650 cfs 345.0 ft. NGVD
5.	Gated Spillway Capacity at Normal Pool Elevation Elevation:	Not applicable
6.	Gated Spillway Capacity at Test Flood Elevation Elevation:	Not applicable
7.	Total Spillway Capacity at Test Flood Elevation Elevation:	650 cfs 345.0

8.	Total Project Discharge at top of Dam: Elevation:	 3400 cfs 348.0 ft.
9.	Total Project Discharge at Test Flood Elevation: Elevation:	 650 cfs 345.0 ft.

c. ELEVATION - Feet above National Geodetic Vertical Datum

1.	Streambed at toe of dam	323 ±
2.	Bottom of Cutoff	N/A
3.	Maximum Tailwater	Unknown
4.	Normal Pool	344
5.	Full Flood Control Pool	N/A
6.	Spillway crest	342
7.	Design Surcharge-Original Design	Unknown
8.	Top of Dam	348
9.	Test Flood Surcharge	345

d. RESERVOIR - Length in feet

1.	Normal Pool	1700
2.	Flood Control Pool	N/A
3.	Spillway Crest Pool	1700
4.	Top of Dam	2700
5.	Test Flood Pool	2000

e. STORAGE - Acre-feet

1.	Normal pool	160
2.	Flood control pool	N/A

3.	Spillway crest pool	160
4.	Top of Dam	220
5.	Test Flood Pool	170
f.	RESERVOIR SURFACE - (Acres)	
1.	Normal Pool	11
2.	Flood Control Pool	N/A
3.	Spillway crest	11
4.	Test Flood Pool	13
5.	Top of Dam	17
g.	DAM	
1.	Type	Earth embankment
2.	Length	870 feet
3.	Height	25 feet
4.	Top Width	Varies 15 ft. minimum
5.	Side slopes	
	Upstream	Approx. 2 H to 1 V
	Downstream	Varies; 2 H to 1 V to 1 H to 1 V
6.	Zoning	Unknown
7.	Impervious Core	Unknown
8.	Cutoff	Unknown
9.	Grout curtain	Unknown
10.	Other	N/A

h.	DIVERSION AND REGULATING TUNNEL	N/A
i.	SPILLWAY	
1.	Type	Natural stream channel
2.	Length of Weir	15± ft. at normal pool
3.	Crest	Approx. El. 342.0 NGVD
4.	Gates	None
5.	Upstream channel	Not observed
6.	Downstream channel	Natural
j.	REGULATING OUTLETS	
1.	Invert	Approx. El. 341 ft NGVD*
2.	Size	3 ft. x 3 ft. gate
3.	Description	Wood sluice gate
4.	Control Mechanism	Wood sluice gate presently inoperable

* Not observed in field, elevation taken from record information

5. Other	Outlet has been apparently closed some flow 1 cfs ± noted at downstream outlet

ENGINEERING DATA

SECTION 2

2.1 DESIGN DATA

There was no design data available for review for this dam. Inspection reports of the dam prepared by Worcester County Commissioners were reviewed. An 1880 plan of the dam is on file at the Worcester County Engineers office. It is questionable that this plan reflects accurately the construction of the dam. The data above is included in Appendix B of this report.

2.2 CONSTRUCTION DATA

No construction data was available for review. The name of the contractor responsible for construction is unknown.

2.3 OPERATIONAL DATA

There is no operational data available for this dam.

2.4 EVALUATION OF DATA

a. AVAILABILITY

Data reviewed was provided by the Worcester County Commissioners. A list of the data available and its location is included in Appendix B of this report.

b. ADEQUACY

The lack of depth of engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history, hydraulic and hydrologic calculations

and sound engineering judgment.

c. VALIDITY

The design plans reviewed did not accurately depict the visible portions of the dam and were not used in assessing the safety of the dam.

VISUAL INSPECTION

SECTION 3

3.1 FINDINGS

a. GENERAL

The visual inspection of the dam was conducted on December 11 and 22, 1980. At the December 11, 1980 inspection, the water level was about 4 ft. below the crest of the dam. At the December 22, 1980 inspection, the water level of the dam was approximately 5 ft. below the crest of the dam. The general condition of the dam at the time of inspection was poor.

b. DAM

The dam is an earthen embankment with a natural spillway and a vertical stone masonry wall along two short sections of the downstream face.

The crest is generally about 17 ft. wide and contains a bare path with scattered patches of grass (Photo # 1). Tree roots up to 3 inches in diameter are exposed at many locations along the crest. Many trees with diameters to 32 inches grow along the upstream and downstream edges of the crest, and some tree stumps to 17 inches were also observed along the edge. In an area about 200 ft. left of the spillway, along the upstream edge, a tire rut is inordinately deep for about 100 ft. This may be indicative of a past rotational slump of the upstream face in this area (See Photo #1 and sketch plan in Appendix B, page B-1). Five holes, which may be animal burrows, were observed at different points along the

crest. The holes ranged in diameter from 14 inches to 29 inches and in depth from 6 to 16 inches. Portions of the crest surface are highly irregular and minor erosion was observed in several places.

The upstream face of the dam ranges in slope from relatively flat and irregular near the right and left abutments to near-vertical in areas due to steepening by wave action. The upstream face was mostly under water; the difference in elevation between the level of the reservoir and the crest of the dam ranged up to about 4 ft. Vegetation along the upstream face varies in type and density but generally consists of saplings and trees to 15 inches diameter, brush, grasses, moss, scattered tree stumps to 20 inches diameter, occasional exposed tree roots, and accumulations of leaves, branches and vegetative debris. Sparse cobble and boulder slope protection was observed in some areas; most of the upstream face is unprotected by riprap which has led to oversteepening, slumping, and erosion at many points along the face.

The slope of the downstream face ranges from 2 H : 1 V to 1 H : 1.5 V and averages about 1 H : 1 V (Photo # 2). Two sections of the downstream face consist of vertical, unmortared stone walls 100 ft. and 20 ft. long and approximately 10 ft. high (Photo # 3). Some blocks in the walls have fallen out or have been displaced in a downstream direction. A small amount of seepage, estimated to be 1 - 2 gpm, was observed flowing from the 20 ft. section of wall near the mill structure (Photo # 4). The seepage was clear with no visible evidence of fines. The slope is moderately to densely

wooded with trees to 22 inches diameter; several tree stumps were observed along the face. Other vegetation includes scattered areas of light to dense brush, moss, occasional grassy areas, and vegetative debris. Many boulders are scattered along the toe of the slope in varying groupings. These boulders may have been dumped to form a type of toe berm, or may have been pushed to the side during emplacement of the earthen dam. Minor erosion and slumping were observed along the downstream face. Several holes, ranging in diameter from 13 to 19 inches and in depth from 14 to 24 inches were observed 2 to 5 ft. down from the edge of the crest. The flat area beyond the toe of the downstream slope is generally wet and spongy along most of the toe of the dam; in one area about 50 ft. wide by 75 ft. long, water has ponded to a depth of approximately 5 inches (Photo # 5).

The right abutment is a natural earth channel which has been intersected by a natural stream which serves as a spillway. Water was flowing through the natural stream course. The left abutment consists of a dirt road which is adjacent to a natural earth slope.

c. APPURTENANT STRUCTURES

A stream at the right abutment forms a natural spillway for the dam (Photo #6). An outlet structure containing an inoperable sluice gate is located on the upstream side of the crest opposite the mill building. The gate appeared closed at the time of inspection. Minor erosion has occurred at the stone masonry entrance to this outlet. The wing walls for this outlet are of stone masonry and are in poor condition (Photo #7). A flow of about 1 cfs was noted at the downstream end of the flume for this outlet.

d. RESERVOIR AREA

The banks of the reservoir in the vicinity of the dam appeared in stable condition.

e. DOWNSTREAM CHANNEL

The natural stream spillway channel is partially blocked with logs, branches, leaves and other debris. The streambed and banks are formed by natural materials, including soils, boulders and bedrock (Photo # 6). The banks are generally oversteepened and rise no higher than approximately 1.5 ft. The flume for the outlet structure passes under the old mill structure which is partially collapsed, exits in back of the mill, disappears underground in an apparent stone conduit, and reappears as a natural stream channel about 125 ft. downstream of the mill. The observed portion of the conduit under the mill was constructed of stone.

3.2 EVALUATION

Based on the visual inspection, the dam appears to be in poor condition. The future integrity of the dam can be affected by the following:

Trees and brush are growing on the upstream and downstream faces of the dam and along the crest. Tree stumps occur along the upstream edge of the crest and the downstream face. These features can contribute to seepage problems if one of the tree clusters blows over and pulls out its roots or if the roots rot.

The upstream face has been eroded and oversteepened by wave action; minor erosion and slumping are occurring at many points along the crest and upstream and downstream faces. One area along the crest, the area of the deep tire rut, has the appearance of being a back scarp for a possible large rotational slump of the upstream face. All of these factors may affect the long term stability of the slope.

Depressions which appear to be animal burrows were observed at several locations on the crest and downstream face. These could lead to seepage and piping if not properly backfilled with appropriate materials.

Seepage was observed flowing from the base of a 20 ft. section of wall near the mill structure, seepage may also be occurring along the toe of the downstream face as evidenced by wet spongy areas and ponding water. This suggests that the line of seepage through the dam may exit at or near the toe of the slope, a condition which could lead to a piping failure of the embankment if the embankment soils are susceptible to piping.

The inoperable sluice gate and flume appeared to be leaking at the time of inspection, if not properly maintained and inspected the flume will provide a path along which interior erosion of the dam may take place.

Debris has accumulated on the natural spillway along the right side of the dam. This lowers the hydraulic capacity of the spillway.

OPERATIONAL AND MAINTENANCE PROCEDURES

SECTION 4

4.1 OPERATIONAL PROCEDURES

a. GENERAL

The dam is used for recreational purposes by its owners. There is no regulation of the level of the reservoir since the outlet sluice gate is inoperable. Water level of the reservoir varies in accordance with the stage-discharge characteristics of the natural spillway on the right end of the dam.

Inspection reports of the dam were prepared by Worcester County Commisioners 3/26/24 and 5/14/63. An 1880 plan of the dam is on file at the Worcester County Engineers office. It is questionable that this plan reflects accurately the construction of the dam. The data above is included in Appendix B of this report.

b. DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no formal warning system in effect at this dam.

4.2 MAINTENANCE PROCEDURES

a. GENERAL

There are no known maintenance procedures followed for this dam.

b. OPERATING FACILITIES

The sluice gate was the only operable portion of this dam requiring maintenance. It is no longer in operation.

4.3 EVALUATION

Procedures should be established to inspect and maintain the dam. Visual inspections by the owners' personnel should be conducted on a monthly basis. These inspections should include the dam embankments, monitoring of leakage at the sluice gate and monitoring areas of possible seepage as noted in Section 3 of this report. In addition the dam should be inspected once a year by a qualified, registered engineer.

At present there is no means of lowering the water level of the reservoir. A means to lower this water level should be provided in cases of emergency and so that the abandoned sluice gate and flume may be inspected and repaired if necessary.

Procedures should be established to include a warning system: the dam should be monitored during periods of exceptionally heavy rainfall and a formal procedure for notifying downstream authorities should be prepared in the event of an emergency.

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

SECTION 5

5.1 GENERAL

Lee Pond Dam is located on Emerson Brook in Uxbridge, Massachusetts approximately one mile upstream of the Route 146 bridge crossing of Emerson Brook and two miles upstream of the confluence with the Blackstone River. The drainage area above the dam is 5.6 square miles. Sparsely settled land ranging in elevation from El.340 ft.± to El.630 ft.± NGVD characterizes this watershed. The land is mostly wooded with numerous swamps and ponds. Sawmill Pond, just upstream of Lee Pond, is formed at the confluence of the two major streams draining the watershed, Scadden Brook and Laurel Brook.

The top of the dam is approximately at El 348 ft. NGVD. There is an abandoned and blocked outlet near the left end of the dam. Outflow is through a natural stream channel at the right end of the dam.

5.2 DESIGN DATA

No design data or hydrologic/hydraulic data were available for review.

5.3 EXPERIENCE DATA

No data was available on past flooding experience or overtopping of the dam.

5.4 TEST FLOOD ANALYSIS

Based on the Corps of Engineers' Recommended Guidelines for Safety Inspection of Dams, the size of the dam is small. The dam

has approximately 220 acre-feet of storage and the dam failure analysis indicates the hazard potential is significant.

Based on the Corps of Engineers' guidelines, the Test Flood should be in the range of a 100 yr. to 1/2 Probable Maximum Flood (PMF). Since the size of the dam is on the low end of its classification, a test flood equal to the 100 yr. flood was selected and calculated using the USGS regional equations for Eastern Massachusetts. The peak inflow to the pond is calculated to be about 660 cfs or 120± cfs per sq. mi. Stage-storage calculations were made by measuring surface areas from USGS topographic maps. The normal pond elevation was assumed to be El. 344 ft. NGVD or about 4 ft. below the top of the dam. The test flood was routed through Lee Pond using techniques from the Corps of Engineers guidelines. An outflow of about 650 cfs was obtained. This outflow gives a Test Flood elevation of 345.0 ft. NGVD and is passed by the natural spillway with a freeboard of approximately 3 ft. The spillway capacity is therefore judged to be adequate.

5.5 DAM FAILURE ANALYSIS

A dam failure analysis was made using the "Rule of Thumb Guidance" provided by the Corps of Engineers. Failure was assumed with water level at the top of the dam, elevation 348 ft. NGVD. The total outflow at assumed failure, with a dam length of 450 ft. and dam height of 25 ft. is about 41,000 cfs. The width of breach was assumed to be 180 ft. The only structure affected by the failure is the mill building. This building would be washed away by the assumed dam failure. There are no other buildings in the downstream area which would be affected by the dam failure.

Two roadways would be subject to overtopping by the dam failure. Mill Street crosses Emerson Brook approximately 2200 ft. downstream of the dam, causing backwater upstream of the roadway embankment during times of high flow. Mill Street would receive major damage. Route 146 crosses Emerson Brook approximately one mile downstream of the dam and is also subject to overtopping. Route 146 would receive some damage due to overtopping. Downstream of Route 146, Emerson Brook runs for approximately one more mile to the Blackstone River. Damage to this downstream area would be minimal as there is little development in the floodplain.

Table 1 summarizes the effects of the assumed dam failure. On the basis of this assumed failure the dam is classified as a "Significant" hazard potential: a breach of the dam may potentially cause the loss of a few lives and appreciable economic loss. A breach of the dam may wash away the mill building, a structure that appears to be inhabited on a seasonal basis, and overtop two roadways.

The dam breach calculations and a description of potential flooding are shown in Appendix D.

table below summarizes the downstream effects of failure of Lee Pond Dam:

ion No. Map)	Distance D/S of Dam (ft.)	Number of Structures	Level Above Stream (ft.)	Flow (cfs) Stage (ft. above stream) Before Failure	After Failure	Comments
	50	1 old mill building	4-5	3419/2.9'	37830/11.4'	Major damage to old mill building on dam embankment. Minor danger of loss of li
	1059-	1 house	30	3419/9.2'	25515/17.6'	
	2036-2359	road	15	3419/16.6'	18817/22.7'	Major damage. Probable wash out.
	2359-	1 house	20	3419/5.2'	18379/11.8'	
	3542-			3419/3.0'	15771/6.7'	
	5213-5686	road	13	3419/5.4	11039/14.7'	Some damage. Possible wash-out.
	5686-			3419/4.8	10738/9.0'	

Table 1 - Summary of Downstream Flooding

EVALUATION OF STRUCTURAL STABILITY

SECTION 6

6.1 VISUAL OBSERVATIONS

The visual observations did not disclose any immediate stability problems. However, leakage at the inoperable sluice gate, trees growing on the upstream and downstream faces, erosion and oversteepening of the upstream face, potential slumping along the upstream face, and potential seepage along the toe of the downstream face could affect the long-term performance of the dam.

6.2 DESIGN AND CONSTRUCTION DATA

No information was available concerning the type of soil in the earth embankment and foundation conditions. Thus the evaluation of stability is based solely on visual inspection.

6.3 POST CONSTRUCTION CHANGES

No information is available regarding post-construction changes.

6.4 SEISMIC STABILITY

The dam is located in Seismic Zone 2 and, in accordance with Phase 1 guidelines, does not warrant seismic analysis.

ASSESSMENT, RECOMMENDATIONS, & REMEDIAL MEASURES

SECTION 7

7.1 DAM ASSESSMENT

a. CONDITION

On the basis of the visual inspection, the dam is judged to be in poor condition. The following conditions can affect the long term performance of the dam:

Trees and brush are growing on the upstream and downstream faces of the dam and along the crest. Tree stumps occur along the upstream edge of the crest and the downstream face. These features could contribute to seepage problems if one of the tree clusters blows over and pulls out its roots or if the roots rot.

The upstream face has been eroded and oversteepened by wave action; minor erosion and slumping are occurring at many points along the crest and upstream and downstream faces. One area along the crest, the area of the deep tire rut, has the appearance of being a back scarp for a possible large rotational slump of the upstream face. All of these factors may affect the long term stability of the slope.

Depressions which appear to be animal burrows were observed at several locations on the crest and downstream face. These could lead to seepage and piping if not properly backfilled with appropriate materials.

Seepage was observed flowing from the base of a 20 ft. section of wall near the mill structure, seepage may also be occurring along the toe of the downstream face as evidenced by wet spongy areas and ponding water. This suggests that the line of seepage through the dam may exit at or near the toe of the slope,

a condition which could lead to a piping failure of the embankment if the embankment soils are susceptible to piping.

Debris has accumulated on the natural spillway along the right side of the dam. This lowers the hydraulic capacity of the spillway.

The inoperable sluice gate and flume appeared to be leaking at the time of inspection, if not properly maintained and inspected the flume will provide a path along which interior erosion of the dam may take place.

b. ADEQUACY OF INFORMATION

The lack of in-depth engineering data did not allow for a definitive review. Therefore the condition of the dam is based on visual inspection.

c. URGENCY

The recommendations and remedial measures described below should be implemented by the Owner within one year after he receives this Phase 1 inspection report.

7.2 RECOMMENDATIONS

The following recommendations should be carried out under the supervision of a qualified, registered engineer:

1. Specify procedures for and oversee removal of all brush and trees along with their root systems growing on the dam. Specify procedures for backfilling with proper materials.

2. Design erosion protection measures for the upstream face and oversee the construction of the erosion protection.

3. Investigate the sources of water for the wet spots and seepage along the toe of the dam and determine the potential effects of seepage on the stability of the dam.

4. Investigate the possibility of a rotational slump along the upstream slope and design remedial measures if required.

5. Provide a means for draining the reservoir.

6. Investigate the need for the existing sluice gate and design repairs or a permanent plug for the flume as required.

7.3 REMEDIAL MEASURES

a. OPERATION AND MAINTENANCE PROCEDURES

1. The Owner should prevent brush and trees from growing on the embankment and within 20 ft. of the downstream face of the dam.

2. The natural spillway channel should be cleared and kept clear of debris.

3. Visual inspections should be performed monthly by the owners.

4. A technical inspection of the dam should be performed once a year by a qualified registered engineer.

5. Institute a formal downstream warning system to include monitoring the dam during extremely heavy rains and procedures for notifying downstream authorities in the event of an emergency.

6. Prepare and institute written maintenance procedures for the dam.

7.4 ALTERNATIVES

There are no practical alternatives to the above recommendations.

APPENDIX A

VISUAL CHECKLIST WITH COMMENTS

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT LEE POND DAM

DATE DECEMBER 11, 1980
& DECEMBER 22, 1980
WEATHER CLEAR, COLD
W.S. EL. 344 U.S.
323 D.S.

PARTY:

1. John F. Modzelewski P.E.	ASEC Corporation - Civil/Structural
2. Richard M. Baker	Vollmer Associates Inc. - Hydrologist
3. Richard F. Murdock P.E.	Geotechnical Engineers Inc. - Geotechnical
4. Richard W. Turnbull	Geotechnical Engineers Inc. - Geotechnical

PROJECT FEATURE	INSPECTED BY
1. Dam Embankment	ASEC,GEI
2. Dike Embankment	None observed
3. Outlet Works - Intake Channel Intake Structure	ASEC, GEI
4. Outlet Works - Control Tower	None observed
5. Outlet Works - Transition & Conduit	ASEC
6. Outlet Works - Outlet Structure & Outlet Channel	ASEC
7. Outlet Works - Spillway Weir, Approach & Discharge Channels	ASEC, GEI
8. Outlet Works - Service Bridge	none

PERIODIC INSPECTION CHECKLIST

PROJECT LEE POND DAM DATE Dec. 22 & Dec. 10, 1980

PROJECT FEATURE see below NAME JFM,RFM,RWT

DISCIPLINE Civil Engineer, Geotechnical Engineer NAME

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	348 NGVD
Current Pool Elevation	344 NGVD
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed.
Pavement Condition	No pavement.
Movement or Settlement of Crest	Parts of crest irregular in shape with ruts and depressions.
Lateral Movement	None observed.
Vertical Alignment	Generally obscured by irregularities in upstream face due to wave action; believed to be good.
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	Generally good; minor erosion at abandoned gatehouse structure.
Indications of Movement of Structural Items on Slopes	None.
Trespassing on Slopes	Recreation activity along dam, reservoir.
Sloughing or Erosion of Slopes or Abutments	Generally minor; potential for one large stump along crest, upstream face
Rock Slope Protection - Riprap Failures	Generally absent or sparse.
Unusual Movement or Cracking at or Near Toe	None observed.
Unusual Embankment or Downstream Seepage	Wet area along most of downstream toe; ponding has occurred; seepage observed from one section of wall downstream.
Piping or Boils	None observed.
Foundation Drainage Features	None observed.
Toe Drains	None observed.
Instrumentation System	None observed.
Vegetation	Brush, trees, and grasses of varying density along upstream and downstream faces, and edges of crest.

PERIODIC INSPECTION CHECKLIST

PROJECT LEE POND DAM DATE Dec. 22, & Dec. 10, 1980

PROJECT FEATURE see below NAME --

DISCIPLINE -- NAME

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	None.
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	
Pavement Condition	
Movement or Settlement of Crest	
Lateral Movement	
Vertical Alignment	
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	
Indications of Movement of Structural Items on Slopes	
Trespassing on Slopes	
Sloughing or Erosion of Slopes or Abutments	
Rock Slope Protection - Riprap Failures	
Unusual Movement or Cracking at or Near Toes	
Unusual Embankment or Downstream Seepage	
Piping or Boils	
Foundation Drainage Features	
Toe Drains	
Instrumentation System	
Vegetation	

PERIODIC INSPECTION CHECKLIST

PROJECT LEE POND DAM DATE Dec. 22, Dec. 10, 1980

PROJECT FEATURE see below NAME JFM, RFM, RWT

DISCIPLINE Civil Engineer, Geotechnical Engineer NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	Abandoned gatehouse.
a. Approach Channel	
Slope Conditions	Under water, therefore not observed.
Bottom Conditions	Under water, therefore not observed.
Rock Slides or Falls	Under water, therefore not observed.
Log Boom	None
Debris	N/A
Condition of Concrete Lining	N/A
Drains or Weep Holes	None observed.
b. Intake Structure	Intake structure abandoned and inoperable
Condition of Concrete	Stone masonry wingwalls on both sides deteriorated, Gate inoperable outlet appears to be plugged
Stop Logs and Slots	Poor condition

PERIODIC INSPECTION CHECKLIST

PROJECT LEE POND DAM DATE Dec. 22 & Dec. 10, 1980

PROJECT FEATURE see below NAME --

DISCIPLINE — NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	None.
a. Concrete and Structural	
General Condition	
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

6

PERIODIC INSPECTION CHECKLIST

PROJECT LEE POND DAM DATE Dec. 22 & Dec. 10, 1980

PROJECT FEATURE see below NAME JFM

DISCIPLINE Civil Engineer NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	Not observed
General Condition of Concrete	Abandoned masonry conduit travels through partially collapsed mill building and outlets downstream of the building. A flow estimated at 1 cfs ± noted from the downstream end of the conduit.
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECKLIST

PROJECT LEE POND DAM DATE Dec. 22 Dec. 10, 1980

PROJECT FEATURE see below NAME JFM, RFM, RWT

DISCIPLINE Civil Engineer, Geotechnical Engineer NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	Stone masonry conduit ends at collapsed portion of Mill building
General Condition of Concrete	N/A
Rust or Staining	N/A
Spalling	N/A
Erosion or Cavitation	N/A
Visible Reinforcing	N/A
Any Seepage or Efflorescence	N/A
Condition at Joints	N/A
Drain holes	None observed.
Channel	
Loose Rock or Trees Overhanging Channel	Channel obscured by brush and debris; water appears to flow out from mill structure, down waterfall into underground stone conduit.
Condition of Discharge Channel	

PERIODIC INSPECTION CHECKLIST

PROJECT LEE POND DAM DATE Dec. 22 & Dec. 10, 1980

PROJECT FEATURE see below NAME JFM, RFM, RWT

DISCIPLINE Civil engineer, Geotechnical Engineer NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Natural spillway channel.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	Occasional.
Floor of Approach Channel	Natural rock and soil.
b. Weir and Training Walls	None - natural channel
General Condition of Concrete	
Rust or Staining	
Spalling	
Any Visible Reinforcing	
Any Seepage or Efflorescence	
Drain Holes	None.
c. Discharge Channel	
General Condition	Generally good, partially blocked.
Loose Rock Overhanging Channel	None observed.
Trees Overhanging Channel	Occasional.
Floor of Channel	Natural rock and soil.
Other Obstructions	
Other Comments	

PERIODIC INSPECTION CHECKLIST

PROJECT LEE POND DAM DATE Dec. 22 & Dec. 10, 1980

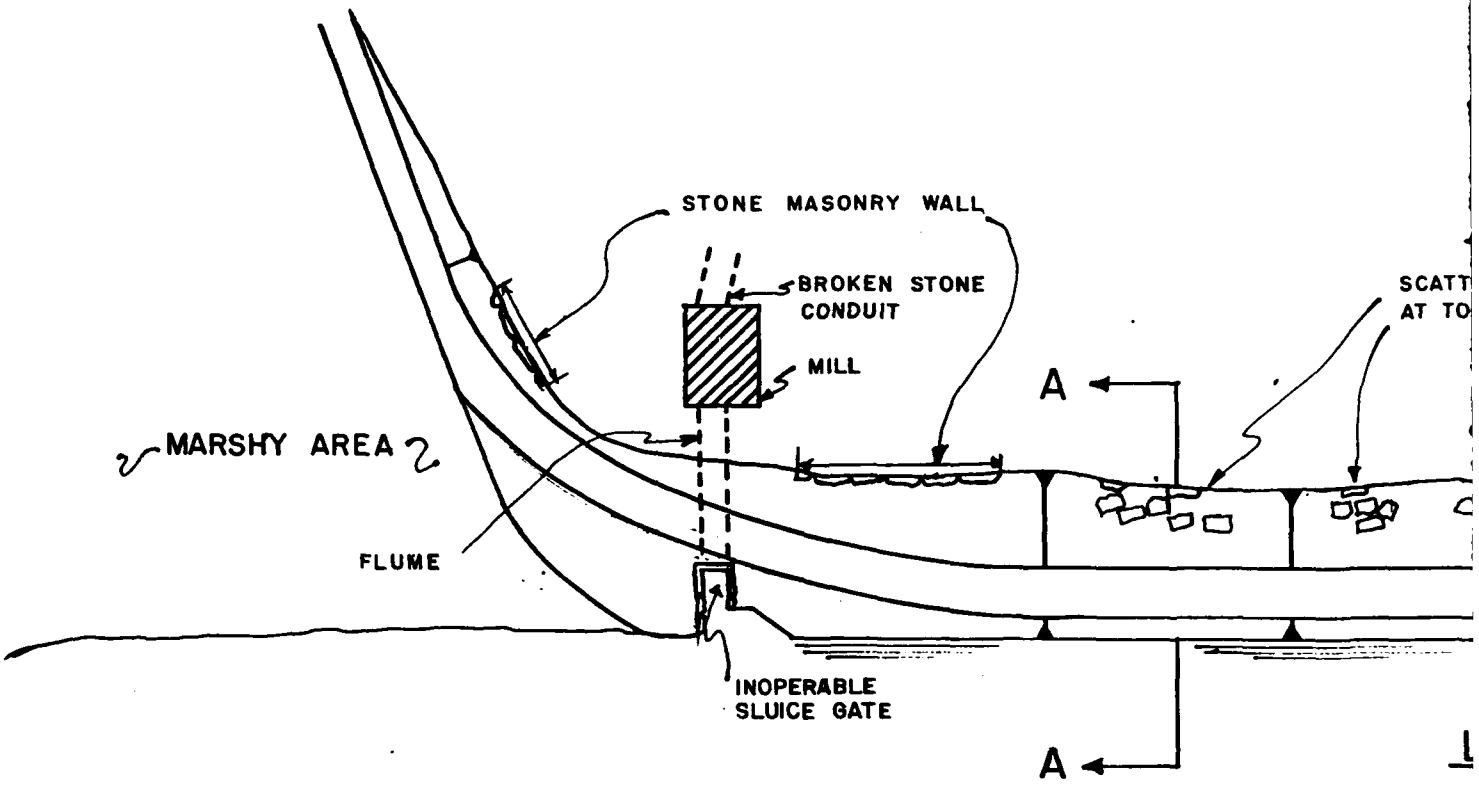
PROJECT FEATURE see below NAME --

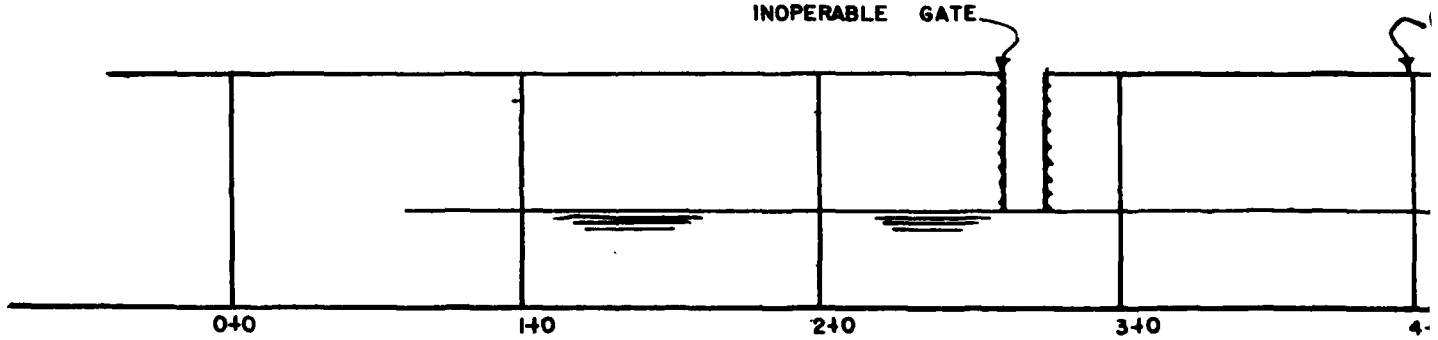
DISCIPLINE -- NAME

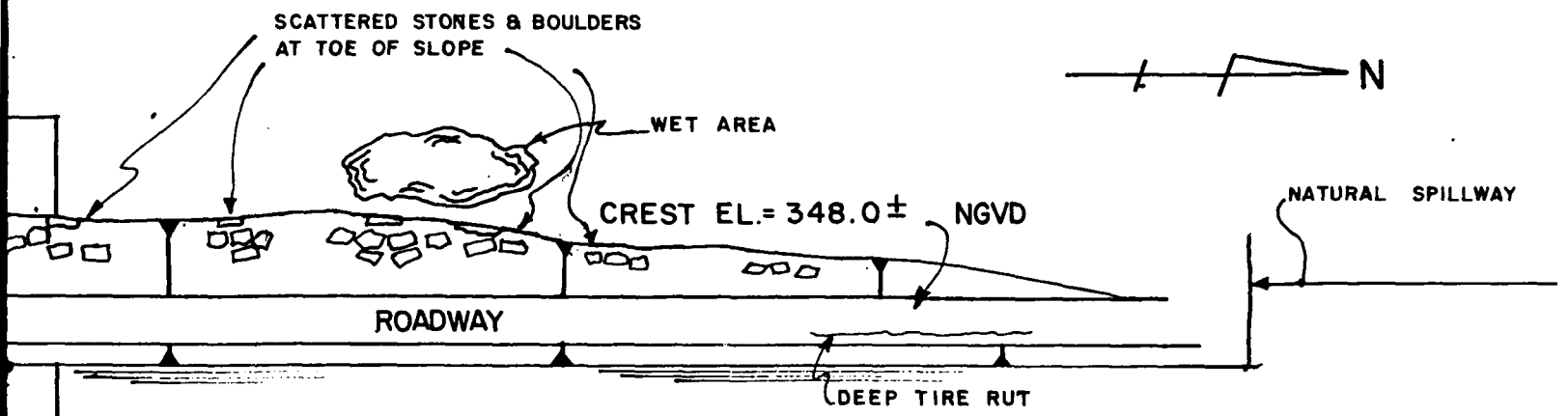
AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	None.
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Underside of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

APPENDIX B

ENGINEERING DATA

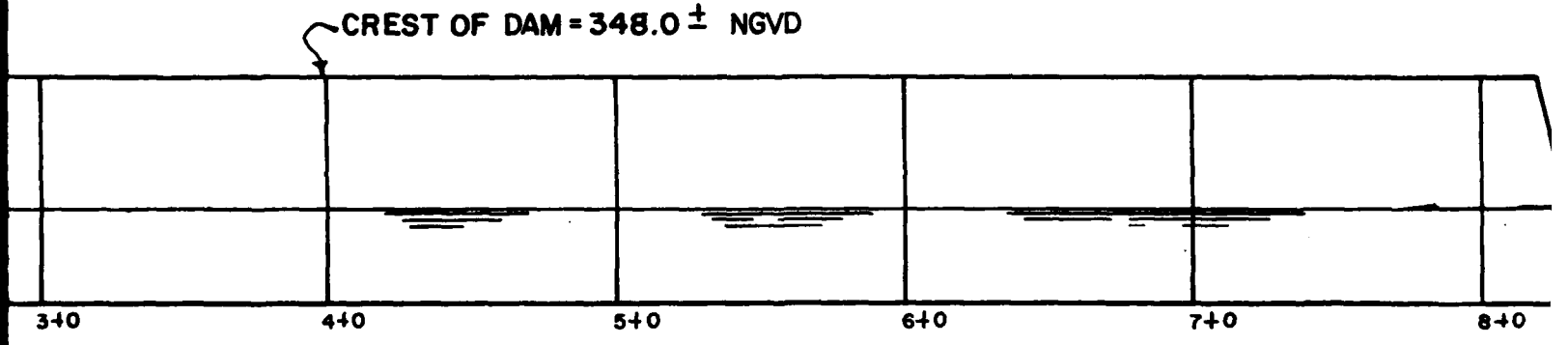

STONE MASONRY WALL
BROKEN STONE CONDUIT
MILL
A
MARSHY AREA
FLUME
INOPERABLE SLUICE GATE
A


INOPERABLE GATE
0+0
1+0
2+0
3+0



LEE POND WATER EL.= 344.0 ± (12-22-80)

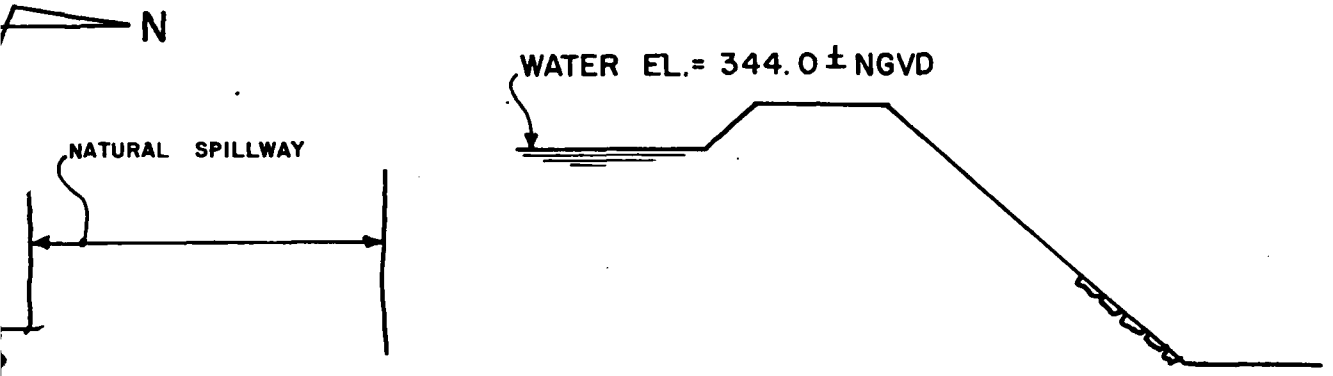
PLAN SCALE: 1" = 60'



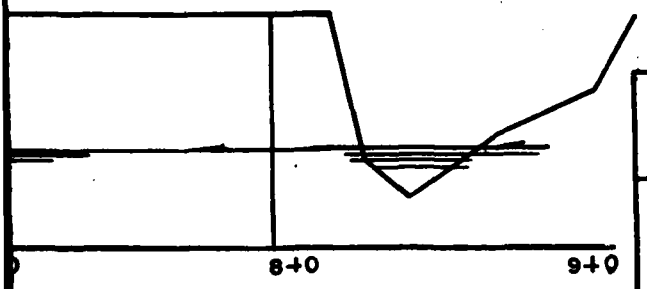
ELEVATION SCALE: H. 1" = 60', V. 1" = 6'

FIG. 2

NOTE:
SKETCH PLAN ONLY.
PREPARED SOLELY FOR THE PURPOSES
OF PHASE I INSPECTION REPORT



SECTION A-A
SCALE: 1"=20'



ASEC CORPORATION *CONSULTING ENGINEERS* BOSTON, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND *CORPS OF ENGINEERS* WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LEE POND DAM
UXBRIDGE, MA.
MA.#00891

DRAWN	CHECKED	APPROVED	SCALE	DATE	PAGE
J.A.P.	J.F.M.		AS SHOWN	MAY, 1981	B-1

LIST OF REFERENCES

REFERENCE	LOCATION
1. Plan of Mill Dam, Uxbridge for Mr. David M. Lee Approved April 1880	County of Worcester, Mass.
2. Worcester County, Mass. Inspection of Dams, Reservoir Dams, & Reservoirs Dam # 53-10 Dated 3-26-24	County of Worcester, Mass.
3. Worcester County, Mass. Inspection of Dams, Reservoir Dams, & Reservoirs Dam # 53-10.1 Dated 3-26-39	County of Worcester, Mass.
4. Worcester County Engineering Dept. Dam Inspection Report Dam # 53-10 Dated May 14, 1963	County of Worcester, Mass.

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L.O.Marden Date 3-26-24 Dam No. 53-10

Town Uxbridge Location Scadden or Emerson Brook.

Owner J.B.Farnum & Son Use Shoddy mill -power

Material and Type Earthern dam. -natural spillway in ledge.

Dam Designed by rs Constructed by E.M.Lee Year 1880

SPILLWAY -prob 50' natural.

El. top Abutment 107.- El. Crest 100 - El. Apron El. Streambed 70.

Width top Abutment 17 Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway ledge

Condition good cut out brush

EMBANKMENT--LENGTH- 550' more or less.

El. Top 107. El. Natural Ground Width Top 17.

Width of Bottom Upstream Slope Downstream Slope part stepped

Kind of Corewall - Riprap stone yes

Material in Embankment earth-clay Foundation rcoky soil

Condition good

GATES Location north end dam.

Size 36" iron to mill Kind tron pipe El. Flowline

Condition good

WHEEL Kind Rodney Hunt Size 24" Rated H. P. 60.

Location Ave. Head 40.

Evidence of Leaks in Structure none

Recent Repairs and Date cut off brush.

Topography of Country below Dam rough-wooded.

Nature of Buildings and Roads below Dam none. except back road.

Number Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

WORCESTER [illegible]

Inspection of Dams, Reservoir Dams [illegible] Reservoirs

Inspected by B.P.St.John & E.S.G. Date [illegible] Dam No. 53-10.1

Town UXBRIDGE Location [illegible] Brook

Owner J.B. Farnum 36 Exchange Place Prov. R.I. Use Boiler

SPILLWAY 450'±

El. top abutment _____ El. Crest _____ El. Bottom _____ El. St. Bed _____

Width top Abut. _____ Width top Crest _____ Width bottom Sp.way _____

Width flashboards _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Pipe _____

Kind of Foundation under Spillway _____

Condition _____

EMBANKMENT 490±

El. Top 100.00 El. Natural Ground [illegible] Width Top 15'

Width of Borrom Sat 60 Upstream Slope _____ Downstream Slope _____

Kind of Corewall None Riprap None

Material in Embankment _____ Foundation _____

Condition _____

GATES _____ Location _____

Size _____ Kind _____ El. Flowline _____

Condition _____

Evidence of Leaks in Structure _____

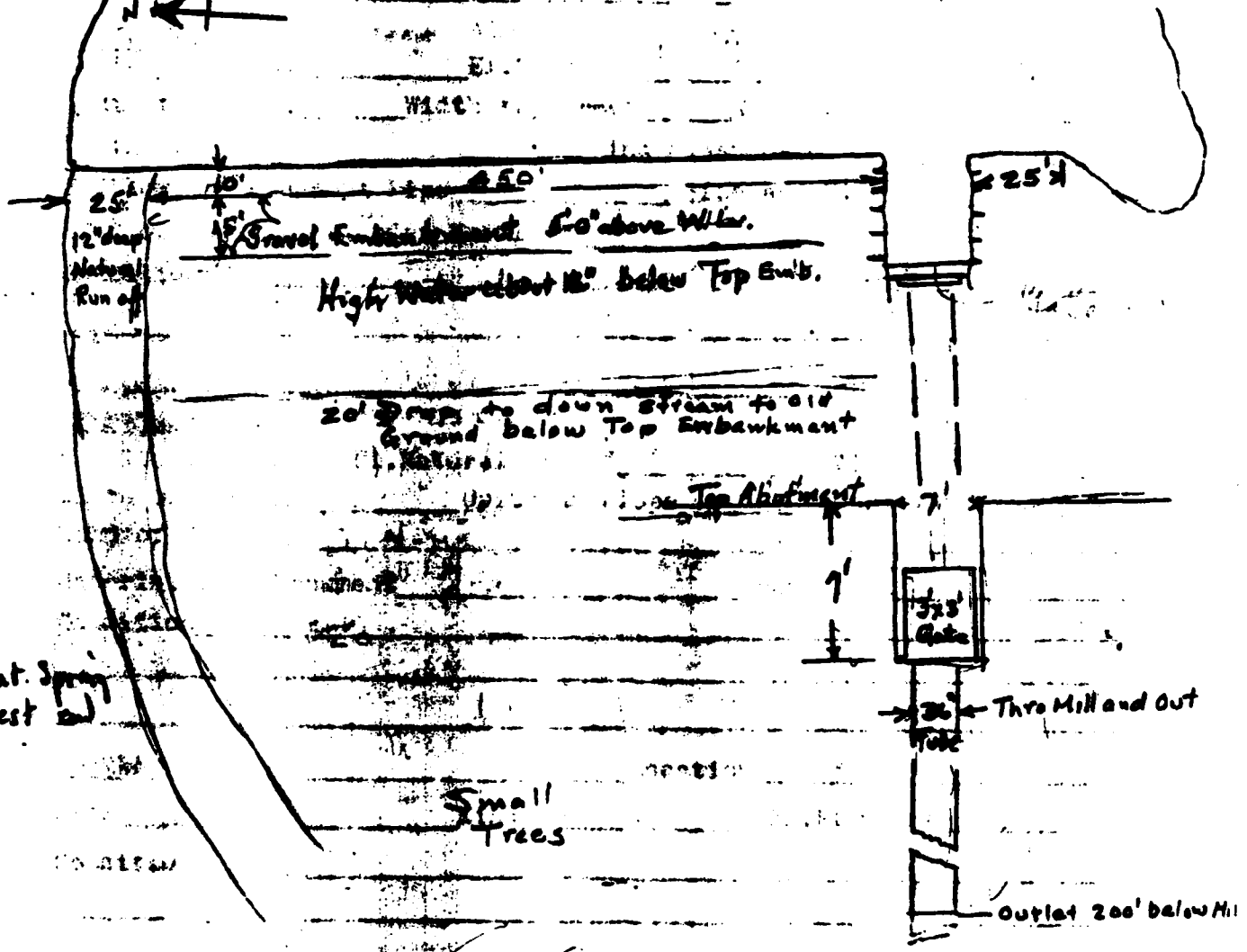
Recent Repairs and Date _____

Number Acres in Pond _____ Drainage Area in Sq. Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

POND


N
450'
25'
10'
5'
Gravel
5.0' above Wier.
12" deep
Natural
Run off
High Water about 18" below Top Emb.
20' Drop to down stream to old ground below Top Embankment
Top Abutment
7'
7'
5'x5' Gate
Nat. Spring
west
Small Trees
Thru Mill and Out
Outlet 200' below Mi
30'
about 30' high
6' freeboard
gate 5'x5' - 3'h sq.

TOWN Uxbridge DAM NO. 58-10

LOCATION S'ly side of Pond St. STREAM Emerson Brook
"Lee Pond."

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by _____ Place Uxbridge Use Mill Pond

Inspected by WDL Date May 14, 1963

Type of Dam Earth and Stone Condition Poor condition

SPILLWAY

Flashboards in Place No boards Recent Repairs None

Condition Natural overflow spillway on southerly end of dam, on ledge

Repairs Needed - width varies from 20' to 50'. Brush and debris should be cleared away from spillway.

EMBANKMENT

Recent Repairs Earth dam @ 20' wide on top - 30' height (Max). Downstream

Condition slope is in very strong condition. Upstream slope is paved and

Repairs Needed is also in very strong condition. Brush should be cleared from Embankment. Old Mill Bldg. below dam, is abandoned.

GATES

Recent Repairs Poor condition - not used for many yrs - probably inoperable.

Condition Rack in bet is clogged with debris. Conc abutment walls

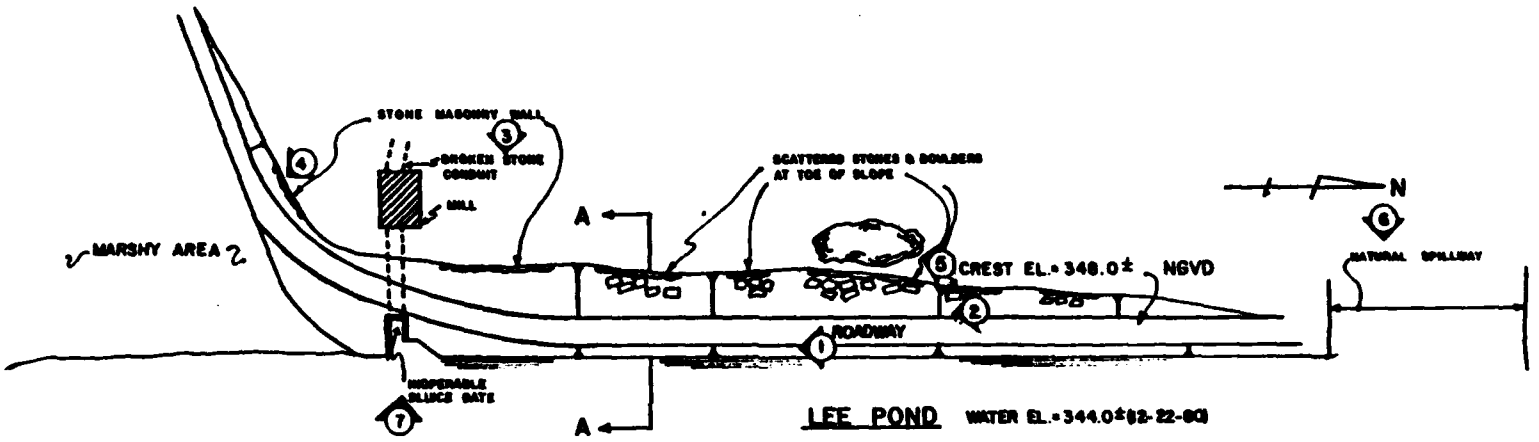
Repairs Needed have collapsed - additional fill and riprap is also required near gate. Gate outlet is also in poor condition.

LEAKS

How Serious 3 small leaks are visible below embankment slope.
Small leak is visible also, at gate outlet.

DATE: _____ County Engineer

FIGURE 3



DENOTES PHOTO NUMBER AND DIRECTION IN WHICH PHOTO WAS TAKEN

ASEC CORPORATION *CONSULTING ENGINEERS* BOSTON, MASS. FEBRUARY 1981	**PHOTO LOCATION PLAN** LEE POND DAM MA 00891 UXBRIDGE, MASSACHUSETTS	U.S. ARMY ENGINEER DIV. NEW ENGLAND *CORPS OF ENGINEERS* WALTHAM, MASS.

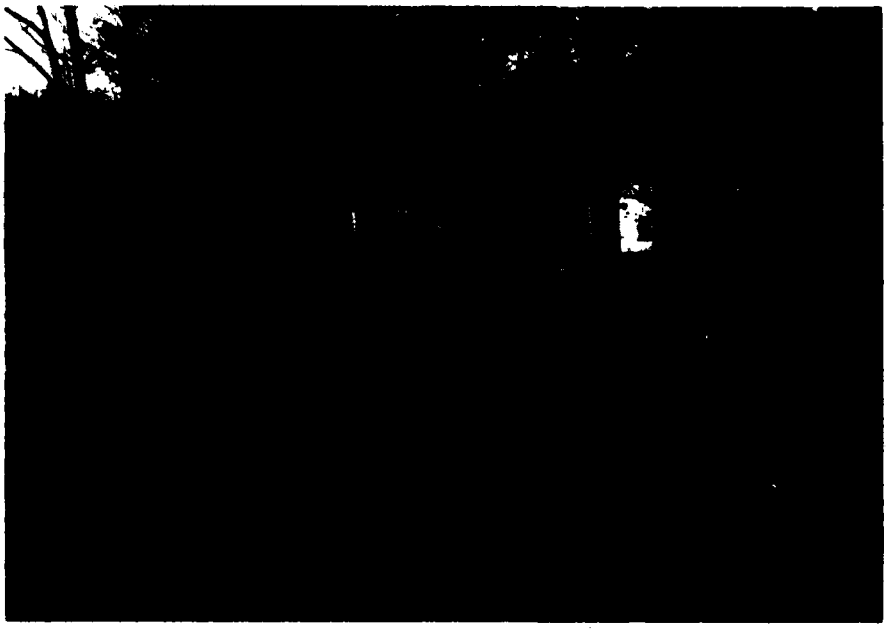


Photo # 1 Crest of dam (Rule extended 6 ft.)

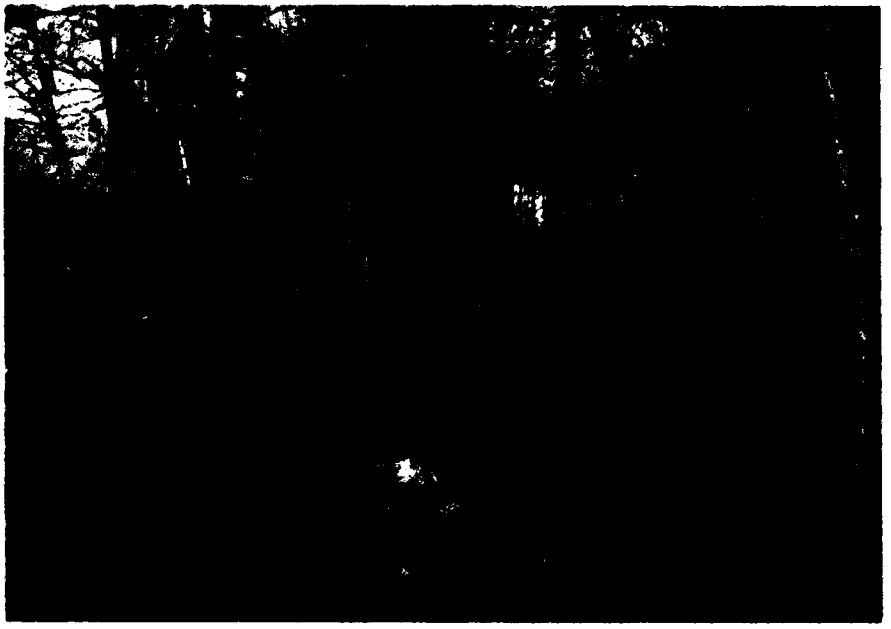


Photo # 2 Downstream face of dam

U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM , MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS	LEE POND DAM TR. TO EMERSON BROOK UXBRIDGE, MASS. MA 00891 DECEMBER 1980
ASEC CORP. CONSULTING ENGINEERS BOSTON , MASSACHUSETTS		

Photo # 3 Vertical wall at downstream face of dam

Photo # 4 Seepage at base of downstream wall
(Rule extended 5 ft.)

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Photo # 5 Wet and spongy area at downstream toe

Photo # 6 Natural stream at spillway, looking upstream
(Approximately 10 ft. wide)

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Photo # 7 Inoperable gate structure
(Rod extended 5 ft.)

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APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

LEE POND DAM

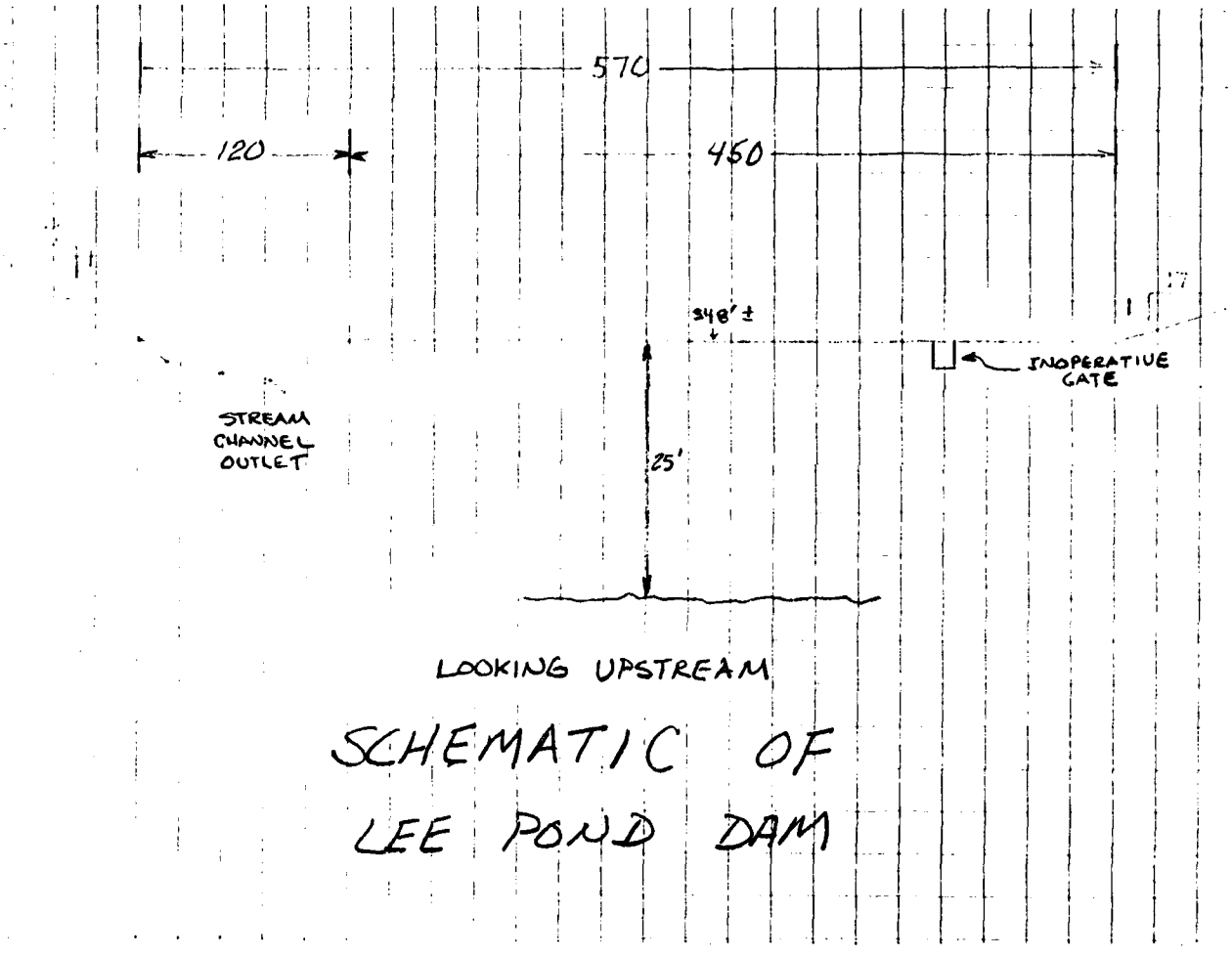
UXBRIDGE, MASSACHUSETTS

Dam Rating Curve

A schematic sketch of the dam and outlet structures is shown in Figure 1. The sketch is based on a recent field inspection and survey of the site. This information was used in the hydrologic and hydraulic analysis of the dam.

The gate on the right side of the dam (looking u/s - Figure 1) controls flow through a sluiceway near an abandoned mill building on the site. At present, this gate is inoperative and outflow now passes over the left side of the dam in a natural stream channel outlet. This natural stream channel outlet is now the main outlet for Lee Pond.

The stage-discharge relationships for this outlet for Lee Pond were computed as part of the HEC-2 mulitple profile analysis on the downstream impact area. The outlet is controlled by stream channel hydraulics not weir flow and has been modeled as such in the HEC-2 analysis. The stage-discharge curve for Lee Pond is shown on Graph 1.



SCHEMATIC OF LEE POND DAM

Figure 1

DAM FAILURE ANALYSIS

Dam Failure with Maximum Pool

Assume that the dam fails with the pool at maximum level, which corresponds to the elevation of the top of the embankment (348.0' NGVD). The gate near the old mill building is inoperative and all outflow passes over the right side of the dam (looking d/s) in a natural stream channel. The channel is located along the west ridge of the floodplain valley in a swale which runs down to the main floodplain farther down stream. The top of the dam embankment is 25' above the floodplain valley at the toe of the dam embankment. The stream channel outlet invert is approximately 19' above the floodplain valley at the toe of the dam embankment.

Normal Outflow at Failure

Q = 3419 CFS (dam rating at maximum pool - 348.0'NGVD - Graph 1).

Tailwater Level at Failure

Cross-sections located throughout the downstream impact area were coded and input into a HEC-2 multiple profile run using nine discharges covering the range of discharges expected during the dam failure analysis. Results were used to construct stage-discharge and stage-cross-section area curves for each cross section (see Graphs 2-9).

The following are locations of cross-sections used in the dam failure analysis:

Distance D/S of Dam (FT)	Normal Water Level (FT-NGVD)
50	341*
1059	310
2036	302.6
2359	300
3142	293.3
3542	290
5213	275
5686	269.5

* Approximate elevation of normal flow in stream channel along west ridge of floodplain valley.

Immediately preceding failure, the normal outflow at maximum pool of 3419 CFS results in an elevation of 343.9' NGVD at the section located 50' downstream of the pond. This is the flow in the stream channel in the swale along the west ridge of the floodplain valley. This flow is not included in the dam failure flow in the flood plain valley 50' downstream of the dam. It is, however, included in the section 1059' downstream of the dam as the outlet stream channel enters the floodplain valley above the section 1059 downstream of the dam.

Breach Outflow

$$Qp_1 = 8/27 \times Wb \times \sqrt{g} \times Y_o^{1.5}$$

where: Wb = width of breach

$\leq$ 0.4 X (width of dam at 1/2 height)

$\leq$ 0.4 X 450

use: Wb = 180'

Y_o = pool elevation - downstream invert = 25.0'

$$Qp_1 = 8/27 \times 180 \times \sqrt{32.2} \times 25^{1.5} = 37,830 \text{ CFS}$$

Total Outflow

$$Q_{total} = 3,419 + 37,830 = 41,249 \text{ CFS}$$

The table below gives pre-failure, downstream stages resulting from entering each section's stage-discharge curve at a discharge of 3419 CFS (normal maximum pool outflow at failure).

Section (FT D.S of dam)	Pre-Failure Stage (FT)
50	343.9*
1059	319.2
2036	319.2
2359	305.2
3142	298.2
3542	293
5213	282.5
5686	274.3

*Elevation of stream flow in channel along west ridge of floodplain valley.

Impounding Capacities of Pond

Pool at top of dam (maximum - 348' NGVD)

Volume = 216 ACRE-FT

Pool at normal storage capacity (COE inventory)

Volume = 160 ACRE-FT

Downstream Flooding

At 50' downstream of dam

Prior to failure

depth = 2.9' (flow in stream channel outlet)

After failure

depth = 334.4' - 323' = 11.4' (Graph #2, floodplain valley only, with Q = 37,830 CFS breach flow)

Reach from 50' downstream to 1059' downstream of dam

To estimate peak dam break flow at a distance 1059' downstream of dam, we follow the COE "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs."

Use stage-discharge and stage-cross-section area curves for sections 50' and 1059' downstream of dam (Graphs 2 and 3).

Storage volume in reach-versus-outflow

Assume channel and overbank storage of the flood wave is equal to the reach length times the average of the upstream post-failure flow area minus the upstream pre-failure flow area and the downstream post-failure flow area minus the downstream pre-failure flow area:

$$\text{Volume } (Ft^3) = \left[\frac{(\ (Ap_1 - A_{n_1}) \ + \ (Ap_1 - A_{n_2}) \ )}{2} \right] X \ L$$

where: Ap_1 = post-failure u/s cross-sectional flow area (Ft^2)

A_{N_1} = pre-failure u/s cross-sectional flow area (Ft^2)

Ap_2 = post-failure d/s cross-sectional flow area (Ft^2)

A_{N_2} = pre-failure d/s cross-sectional flow area (Ft^2)

L = reach length in feet

The attenuation of dam failure flow due to storage in the reach between 50' and 1059' d/s:

$$Q_2 = 3419 + Q_{p_1}\left(1 - \frac{V_1}{S}\right) = 3419 + 37,830\left(1 - \frac{V_1}{216}\right)$$

where: V_1 = volume of storage in reach, above pre-failure stage (ACRE-FEET)

S = storage in reservoir before failure (ACRE-FEET)

Qp_1 = breach outflow at upstream end of reach

Q_2 = total outflow at downstream end of reach after dam failure.

The attenuation of the peak dam failure flow at the downstream end of this reach is calculated on Graph #3. The low swampy floodplain valley in this reach reduces the peak failure flow to 25,515 CFS at the section 1059' d/s of the dam. The corresponding stage of 327.6' is 8.4' above pre-failure stage and 17.6' above normal stream level.

There is an old mill building, today apparantely used as a storage shed by a local resident, located on the dam embankment. This building would receive major damage. If occupied at the time of failure, there is a danger of loss of life. There are no other affected structures in this reach.

Between 1059' and 2036' d/s of the dam, the peak failure flow is attenuated to 19,297' CFS (Graph #4). The stage decreases only slighltly however from 327.6' NGVD at 1059' to 325.0' NGVD at 2036' d/s of the dam. This is due to the backwater and ponding effects caused by Mill Street. There are no structures affected in this reach.

The peak failure flow is attenuated to 18379 CFS at 2359' d/s of the dam (Graph #5). The corresponding stage is 311.8' NGVD which is 6.6' above pre-failure stage and 11.8' above normal stream level. At about 2205 d/s of the dam, Mill Street crosses Emerson Brook with a stone arch culvert which causes the severe backwater upstream of the roadway embankment. This roadway is subject to overtopping and wash-out by the flood-wave. There are no structures affected in this reach.

Between 2359' and 3142' d/s of the dam the peak failure flow is attenuated to 16,701 CFS (Graph #6). The stage is reduced from 311.8' NGVD at 2359' to 302.0' NGVD at 3142 d/s of the dam. The stage of 302.0' NGVD is 3.8' above pre-failure stage and 8.7' above normal stream level. There are no structures affected in this reach.

Beteween 3142' and 3542' d/s of the dam, the floodplain widens near the confluence of Happy Hollow Brook. The failure flow is attenuated to 15,771 CFS with a corresponding stage of 296.7' NGVD (Graph #7). There is nothing affected in this reach.

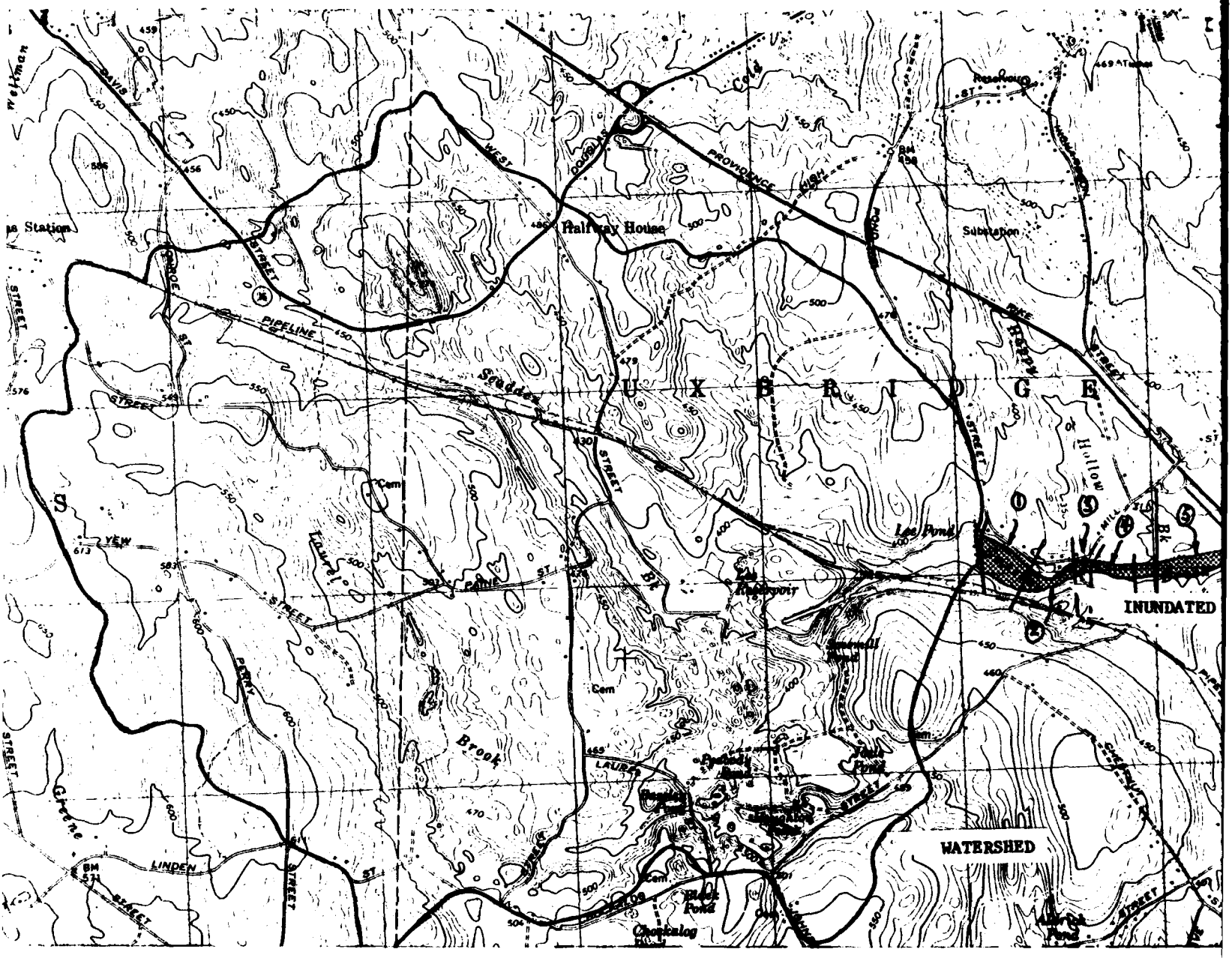
The peak failure flow is attenuated to 11236 CFS at 5213' d/s of the dam. This corresponds to a stage of 288.5' NGVD, which is 6.0' above pre-failure stage and 12.5' above normal stream level. The floodplain in this area just u/s of Route 146 is characterized by wide low swampy areas. There are no structures affected in this reach (Graph #8).

The peak failure flow is attenuated to 10738 CFS at 5686' d/s of the dam. This corresponds to a stage of 278.5' NGVD which is 4.2' above pre-failure stage and 9.0' above normal stage. Route 146 crosses Emerson Brook in this reach at about 5400' d/s of the dam. This roadway is subject to overtopping and possible wash-out by the flood wave. There are no structures affected in this reach (Graph #9).

Downstream of Route 146, Emerson Brook runs for approximately another mile to the Blackstone River. Damage to this downstream area would be minimal as there is little development in the floodplain. The flood wave would be totally attenuated by the natural floodplain storage before it reaches the Blackstone River.

The table below summarizes the downstream effects of failure of Lee Pond Dam:

Location No. (See Map)	Distance D/S of Dam (ft.)	Number of Structures	Level Above Stream (ft.)	Flow (cfs) Stage (ft. above stream) Before Failure	After Failure	Comments
1	50	1 old mill building	4-5	3419/2.9'	37830/11.4'	Major damage to old mill building on dam embankme Minor danger of loss of
2	1059-	1 house	30	3419/9.2'	25515/17.6'	
3	2036-2359	road	15	3419/16.6'	18817/22.7'	Major damage. Probable wash out.
4	2359-	1 house	20	3419/5.2'	18379/11.8'	
5	3542-			3419/3.0'	15771/6.7'	
6	5213-5686	road	13	3419/5.4	11039/14.7'	Some damage. Possible wash-out.
	5686-			3419/4.8	10738/9.0'	



WATERSHED PLAN / CROSS-SECTION LOCATIONS

SEC CORPORATION

LEE POND DAM

UXBRIDGE, MASSACHUSETTS

UXBRIDGE QUADRA

1" = 2083.3'

Test Flood Analysis

Size Classification: SMALL (storage greater than or equal to 50 and less than 1000 acre-feet; height 40')

Hazard Classification: SIGNIFICANT (based on chance of loss of a few lives and damage to the Mill building and some damage to Mill Street and Route 146.

According to COE "Recommended Guidelines" the size and hazard classifications of the dam indicate a test flood in the range of a 100 year flood and 1/2 PMF. Since the size of the dam is on the low end of the size classification, a 100 year flood was chosen for the test flood.

The U.S.G.S. Regional Equations for Eastern Massachusetts were applied to the drainage area above the dam to determine the 100 year peak discharge inflow to the pond.

Drainage area = 5.59 square miles

Main Channel Slope 59.5 ft./mile

$$Q_{100} = 53.86 \times A^{0.807} \times S^{1}0.272$$

$$Q_{100} = 656 \text{ CFS}$$

Stage Storage Curve

The storage at normal pool elevation (344' NGVD from USGS quadrangle map) is approximately 160 acre-feet. The pond surface area at 344' NGVD is approximately 11 acres as measured from the USGS quadrangle map. The pond surface area at 48' NGVD, the dam crest elevation, is approximately 17 acres as measured from the USGS quadrangle map.

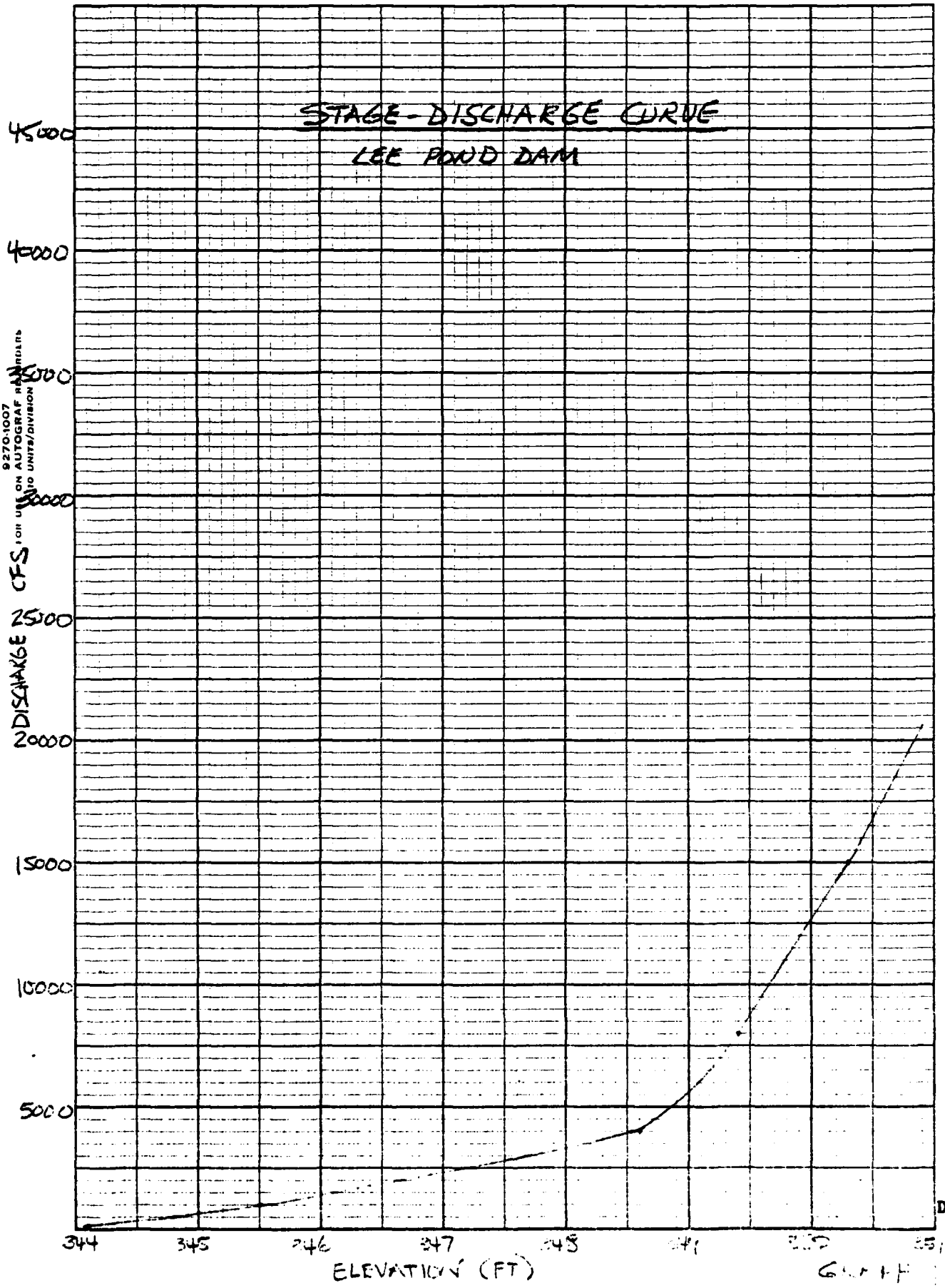
The storage is computed as follows:

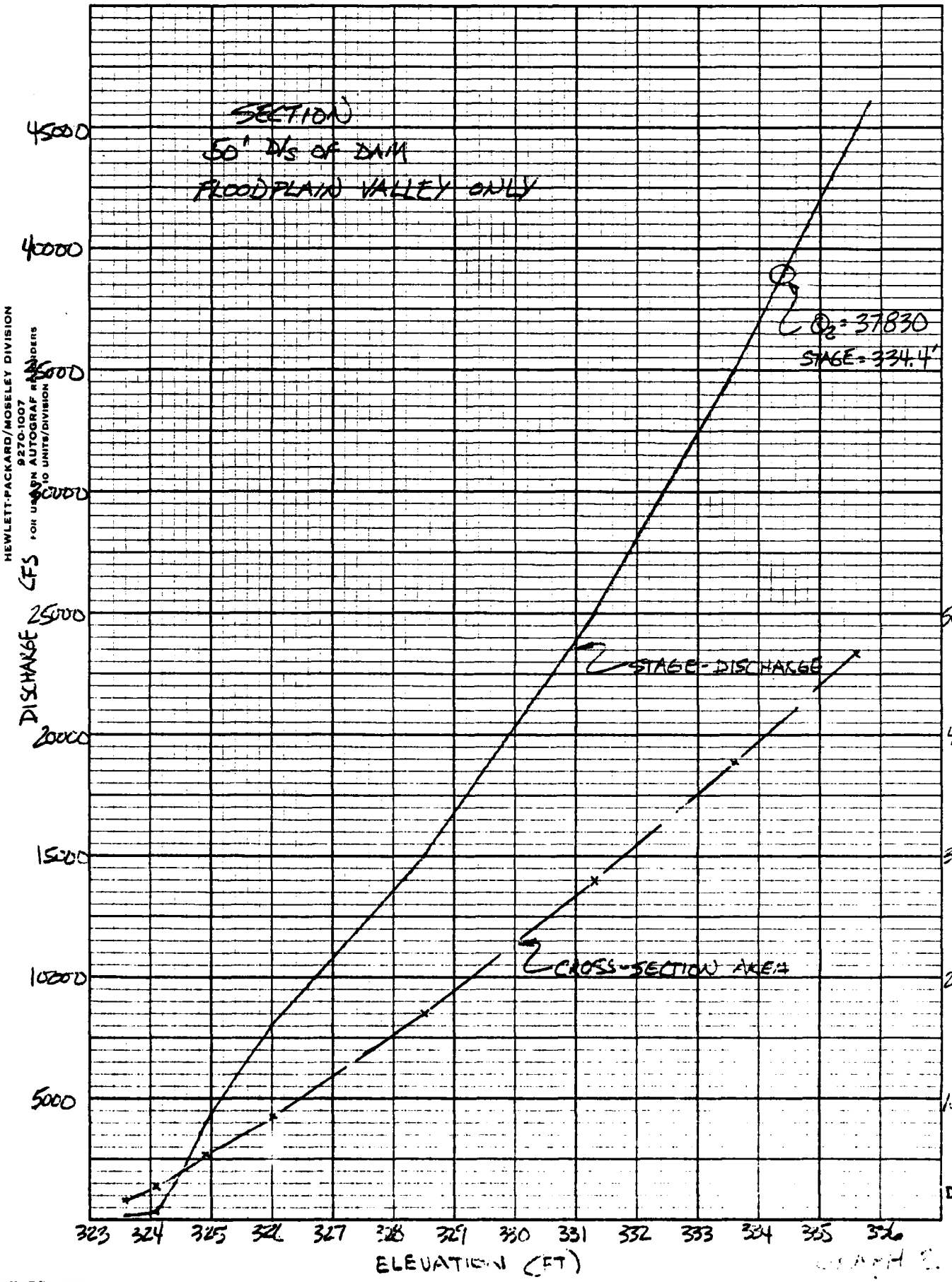
$$\text{Surcharge Storage} = \frac{11 + 17}{2} \times h = 14 \times 4 = 56 \text{ acre-feet}$$

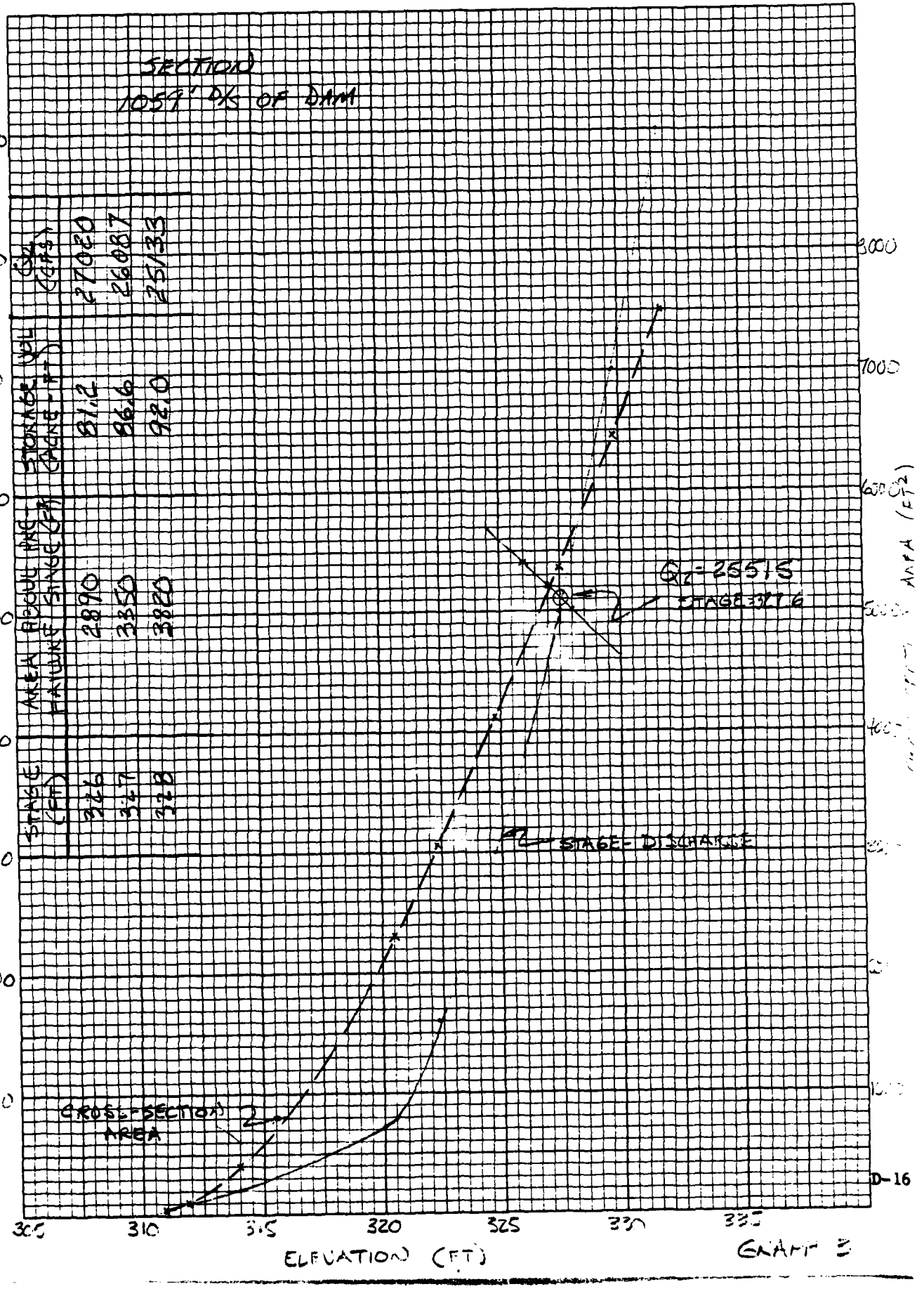
$$\text{Total Storage} = 160 + 56 = 216 \text{ acre-feet}$$

The stage-storage curve is given on Graph #10.

STAGE-DISCHARGE CURVE
LEE POND DAM




SECTION
50' Ds of DAM
FLOODPLAIN VALLEY ONLY
Q_2 = 37830
STAGE = 334.4'
STAGE-DISCHARGE
CROSS-SECTION AREA
DISCHARGE CFS
ELEVATION (FT)
45000
40000
35000
30000
25000
20000
15000
10000
5000
323
324
325
326
327
328
329
330
331
332
333
334
335
336
HEWLETT-PACKARD/MOSELEY DIVISION
9270-1007
FOR USE IN AUTOGRAF RECORDERS
10 UNITS/DIVISION



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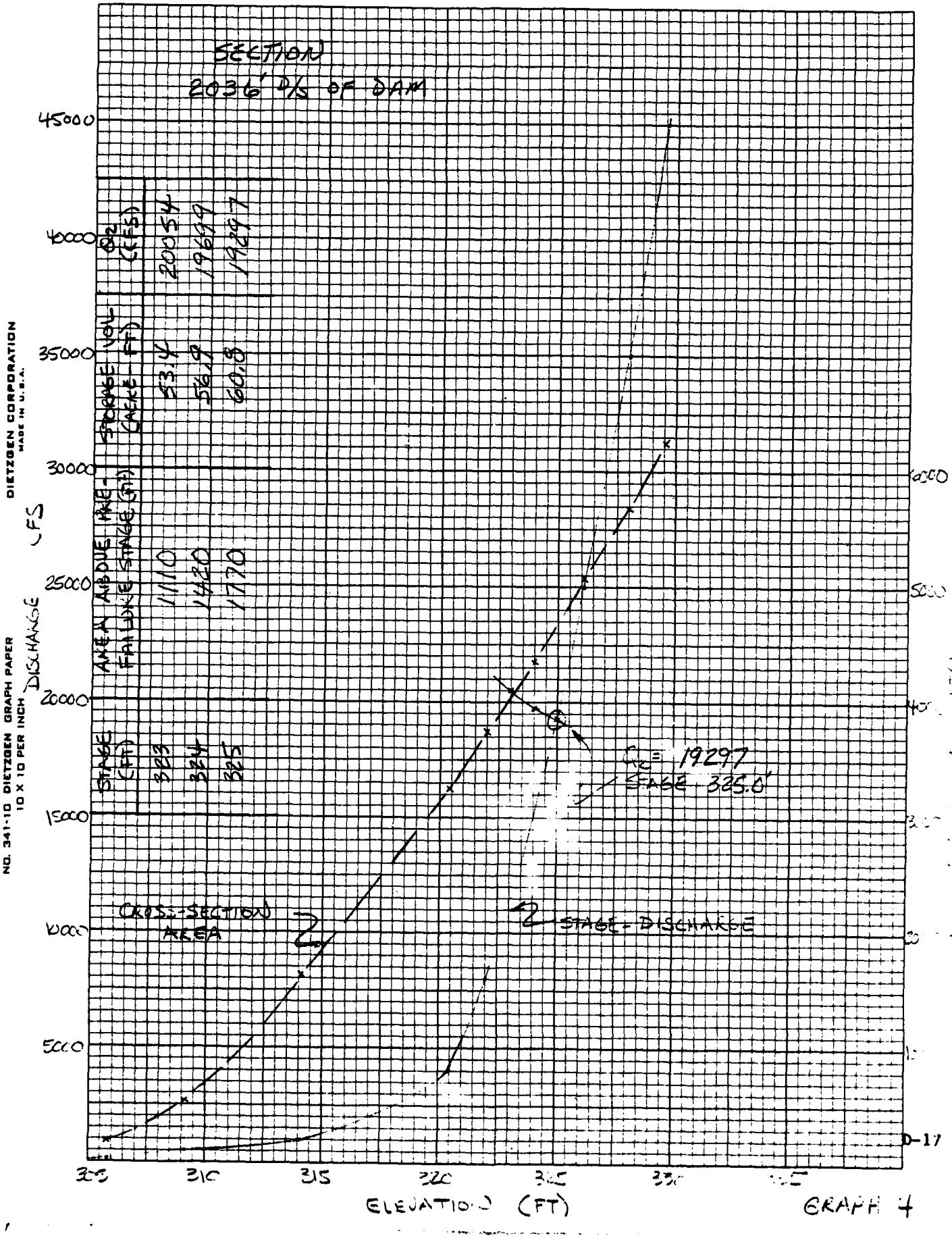
GRAPH 2


SECTION
2036' D/S OF DAM
45000
40000
35000
30000
25000
20000
15000
10000
5000
DISCHARGE CFS
STAGE (FT)
AREA
ABOVE FAILURE STAGE (SQ FT)
STORAGE VOL (ACRE-FT)
Qx (CFS)
323 1110 533 20054
324 1420 569 19619
325 1770 608 19297
Qx = 19297
STAGE 325.0'
CROSS-SECTION AREA
STAGE - DISCHARGE
315
320
325
ELEVATION (FT)
GRAPH 4
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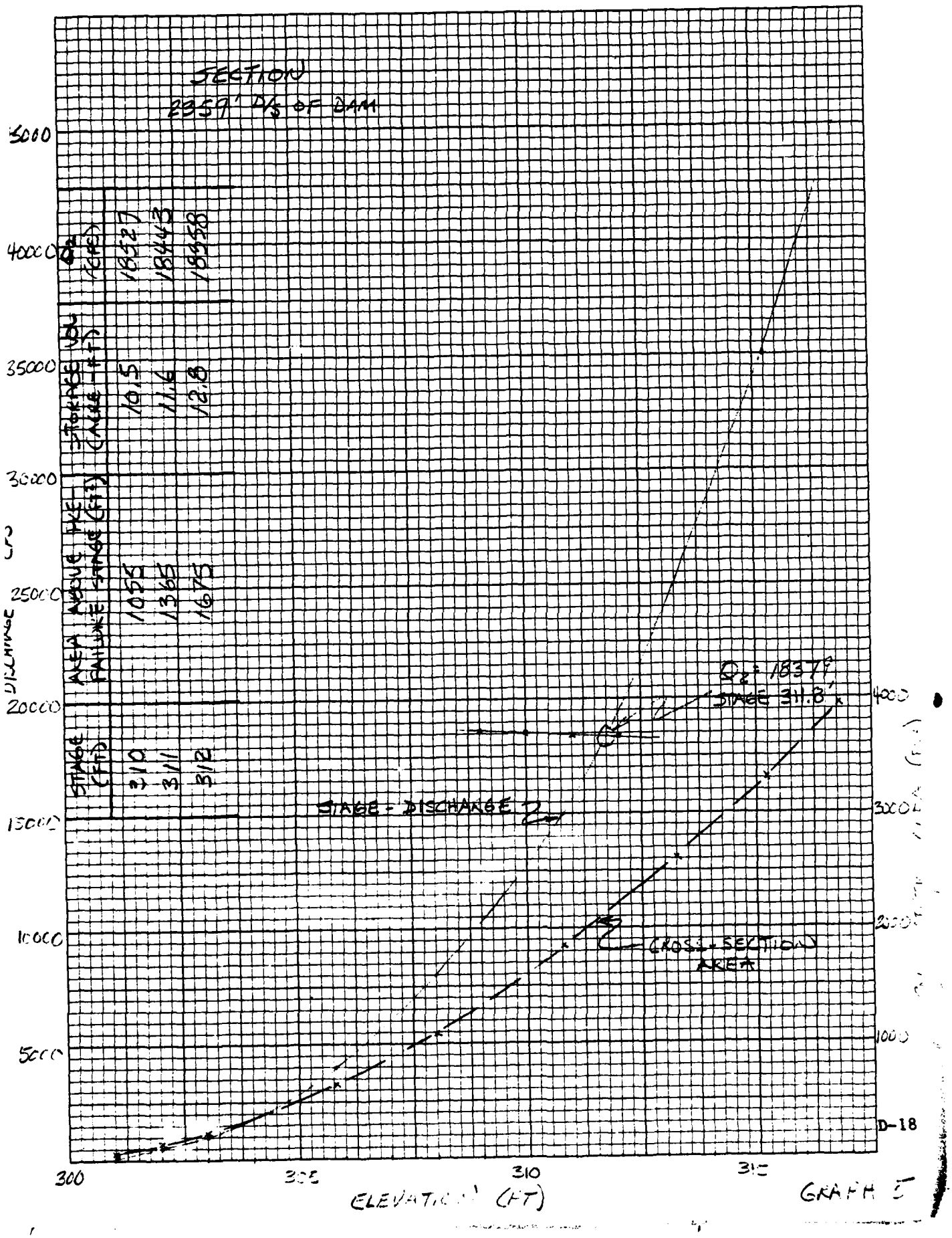
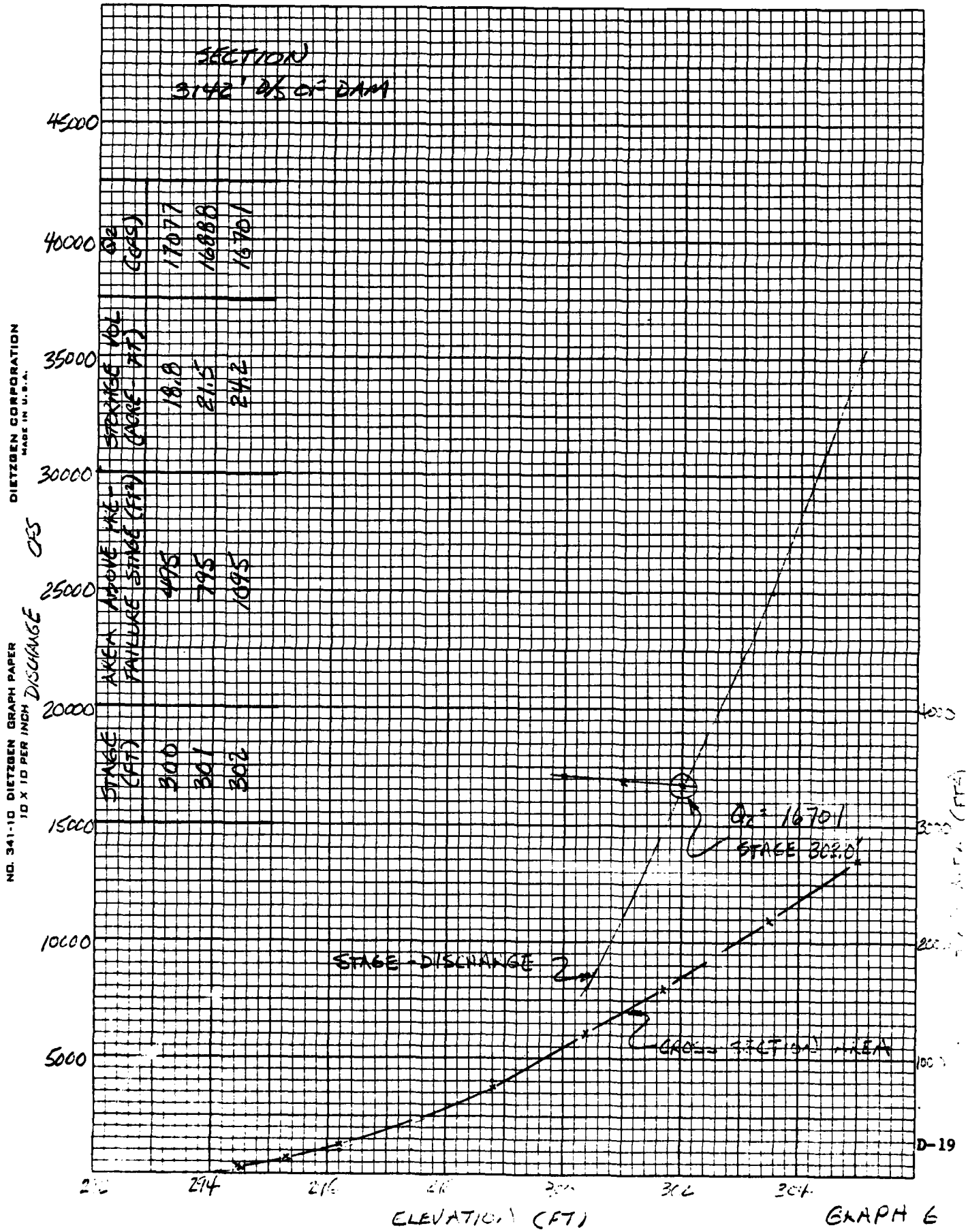

SECTION
2959' D/S OF DAM
STAGE (FT)
AREA ABOVE THE FAILURE STAGE (FT²)
STORAGE ABOVE THE FAILURE STAGE (ACRE-FT)
Q (CFS)
310
311
312
1056
1365
1675
10.5
11.6
12.8
18327
18443
18458
Q = 18379
STAGE 311.8'
STAGE = DISCHARGE
CROSS-SECTIONAL AREA
DISCHARGE
ELEVATION (FT)
300
310
5000
40000
35000
30000
25000
20000
15000
10000
5000
4000
3000
2000
1000
D-18
GRAPH 5


SECTION
3142' 25 OF DAM
45000
40000
35000
30000
25000
20000
15000
10000
5000
STAGE (FT)
AREA ABOVE LAKE FAILURE STAGE (SQ FT)
STORAGE VOL (ACRE-FT)
Q2 (CFS)
300
301
302
405
795
1095
18.8
21.5
24.2
17077
16888
16701
Q2 = 16701
STAGE 302.0'
STAGE - DISCHARGE
294
296
298
300
302
304
ELEVATION (FT)
DISCHARGE
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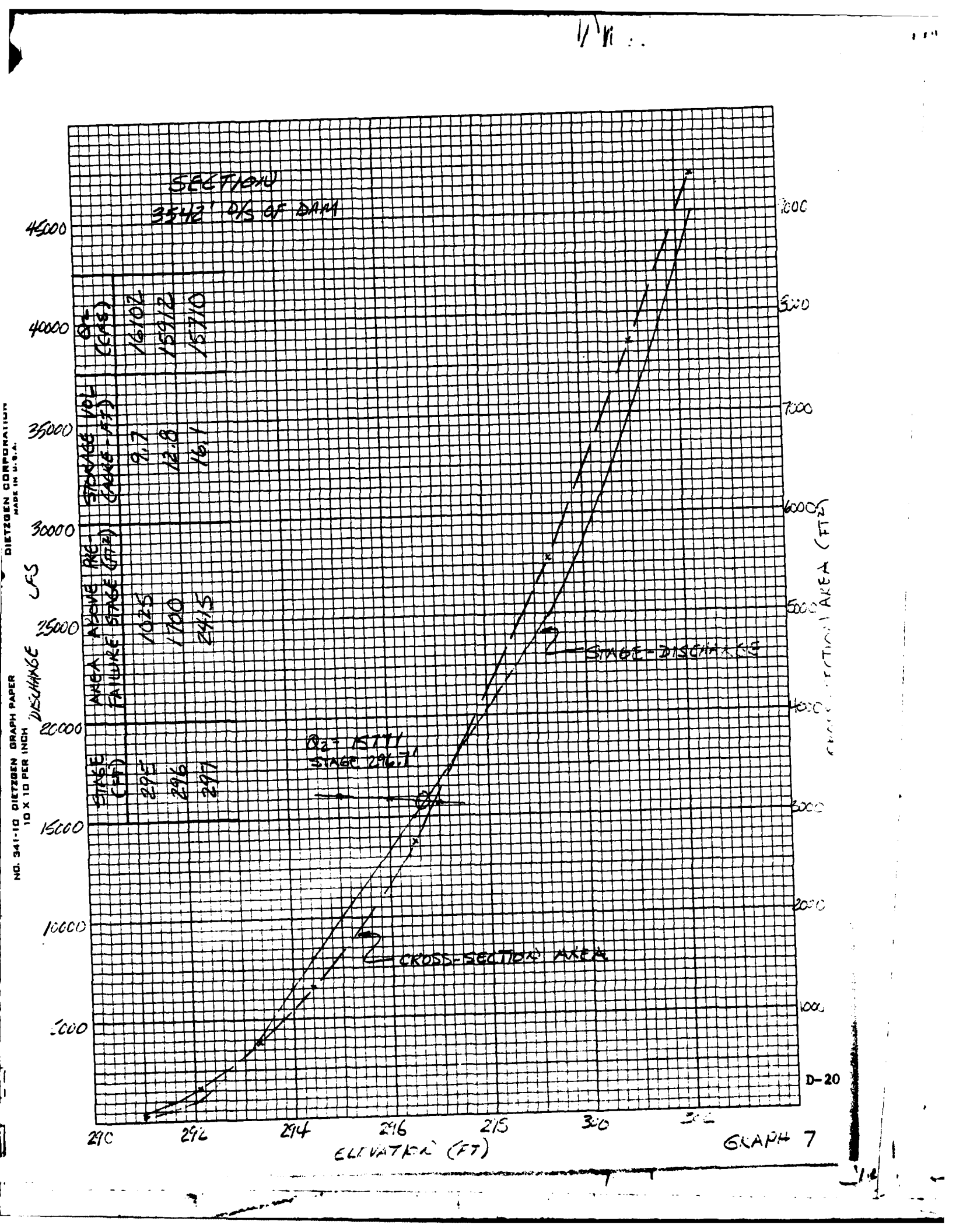
GRAPH 6



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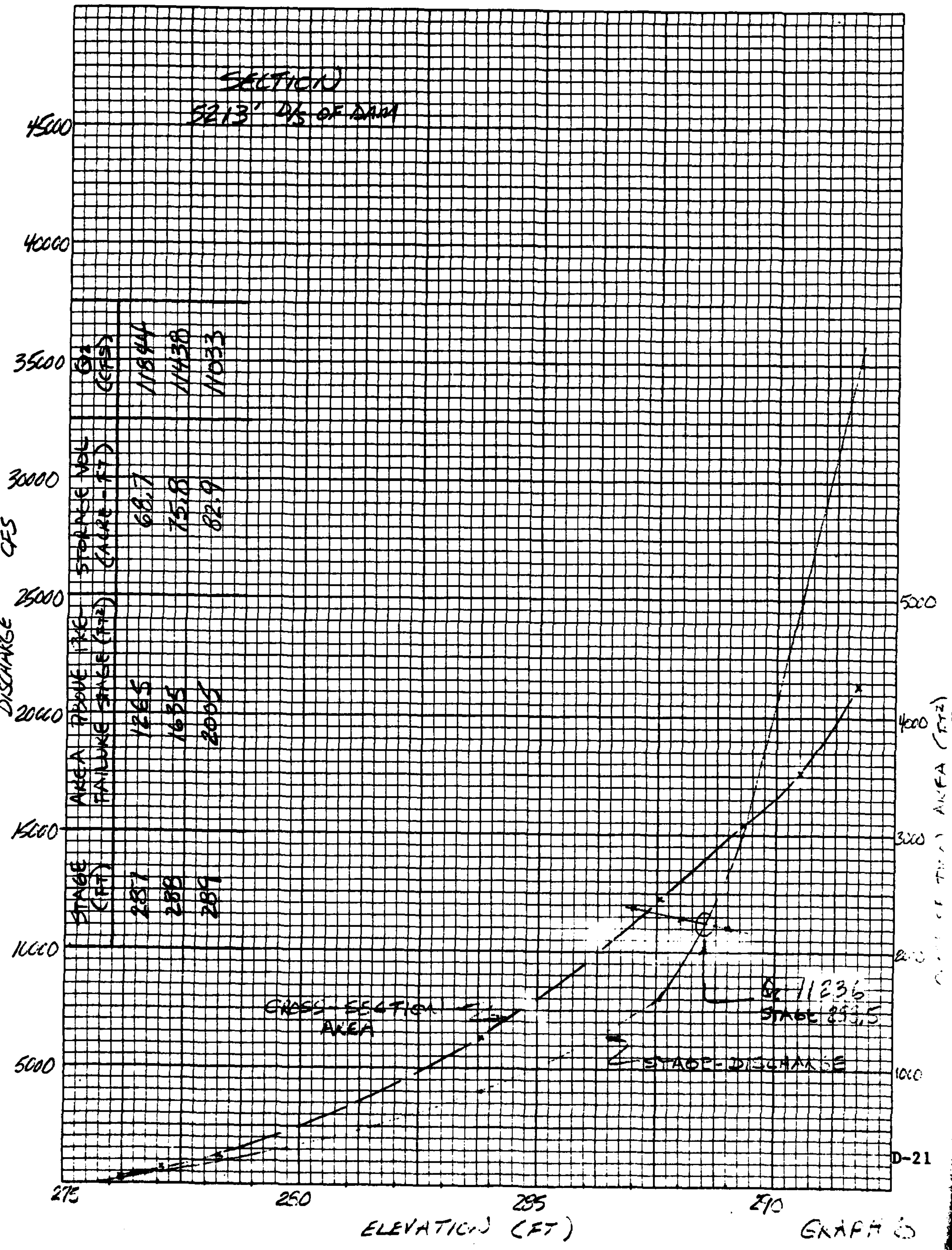
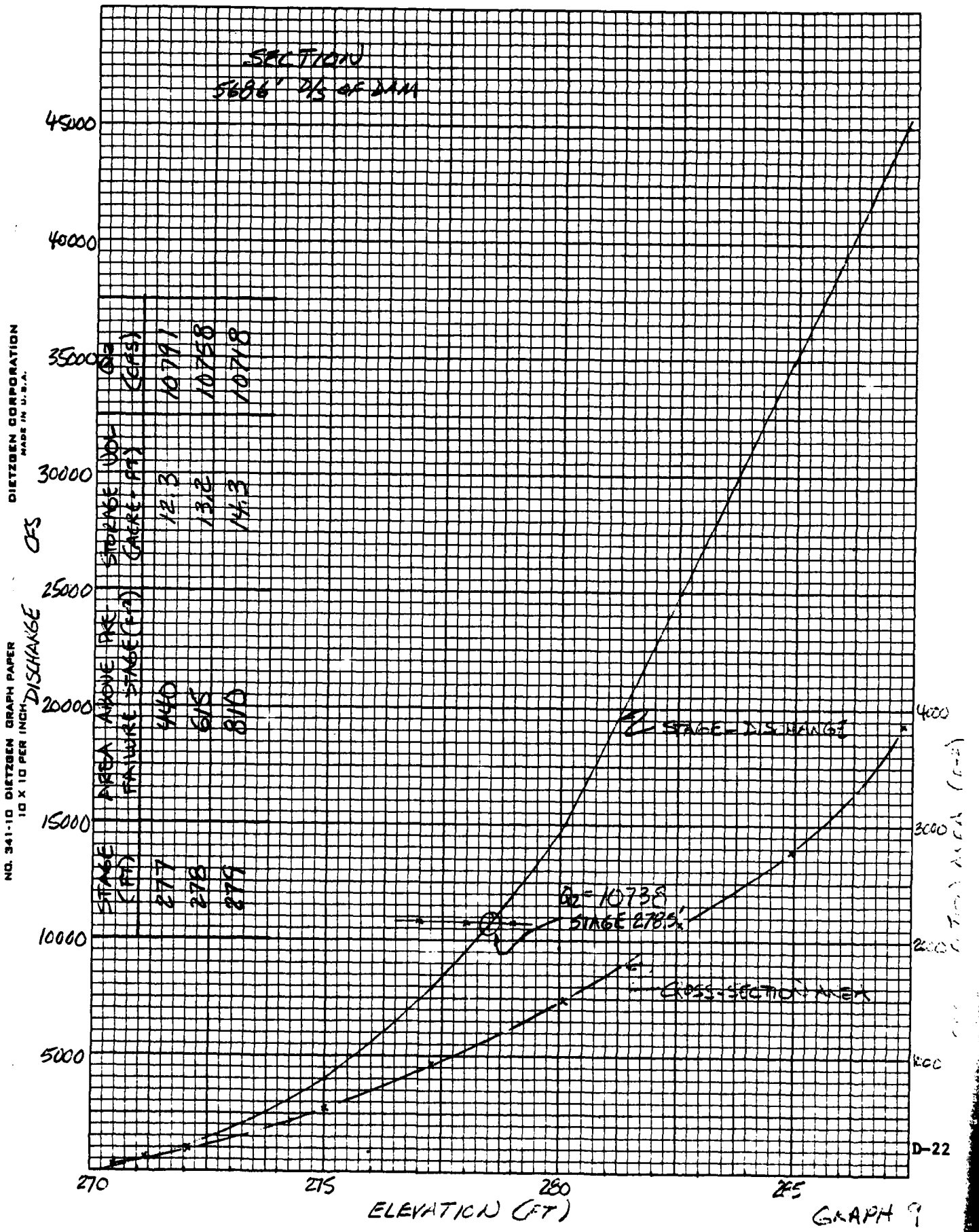


STAGE (FT)	AREA ABOVE THE FAILURE STAGE (FT²)	STORAGE VOL (ACRE-FT)	Q2 (CFS)
287	1265	68.7	11844
288	1635	75.8	11438
289	2005	82.9	11033


SECTION
5686' N/S of DAM
45000
40000
35000
30000
25000
20000
15000
10000
5000
DISCHARGE CFS
STAGE (FT)
AREA ABOVE INV. (SQ FT)
STORAGE VOL. (ACRE-FT)
Q (CFS)
277
279
276
440
615
810
12.3
13.2
14.3
10791
10758
10718
STAGE-DISCHARGE
Q= 10738
STAGE 278.5'
CROSS-SECTIONAL AREA
270
275
280
285
ELEVATION (FT)
4000
3000
2000
1000
D-22
GRAPH 9
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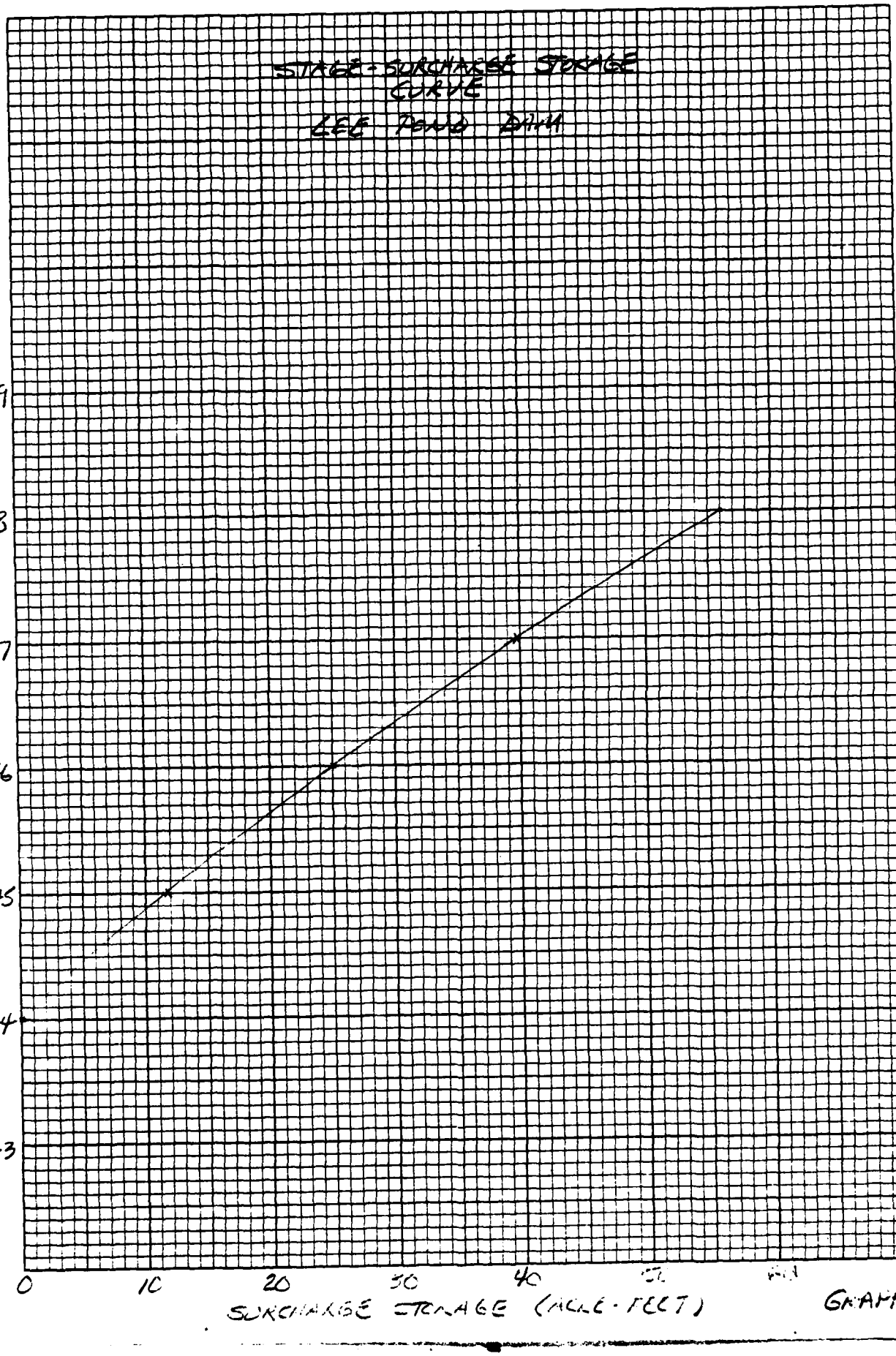

STAGE - SURCHARGE STORAGE CURVE
LEE POND DAM
DIETZGEN CORPORATION
MADE IN U.S.A.
NO. 341-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH
STAGE (FT)
349
348
347
346
345
344
343
0
10
20
30
40
SURCHARGE STORAGE (ACRE-FEET)

GRAPH 10

STAGE - DISCHARGE CURVE

LEE POND DAM

STAGE (FT)	SURCHARGE STORAGE (ACRE - FEET)	STOR. (SUR. STOR. X 0.0834") (INCHES RUNOFF)	Q_{P2} (CFS)
345	11.75	0.04	650
345.5	18.4	0.06	647
346	25	0.09	642

PMF P_6 = 19"
100 YR ~ ½ PMF = 14.75"
100 YR 24 HOUR PRECIPITATION = 6.7"

Assume Soil Conservation Service. $CN_{(AMC)} = 75$
For 6.7" Rainfall Then P_6 = 3.9"

Average: 4.75" + 3.9" = 4.3" P_6
say 100 YR = 4.3" P_6

$$Q_{P2} = Q_{P1}\left(1 - \frac{STOR}{6.7"}\right) = 656\left(1 - \frac{STOR}{4.3"}\right)$$

Q_{P2} = 650 CFS
STAGE = 345'

TOP OF DAM

DISCHARGE CFS

ELEVATION (FT)

GRAPH 11

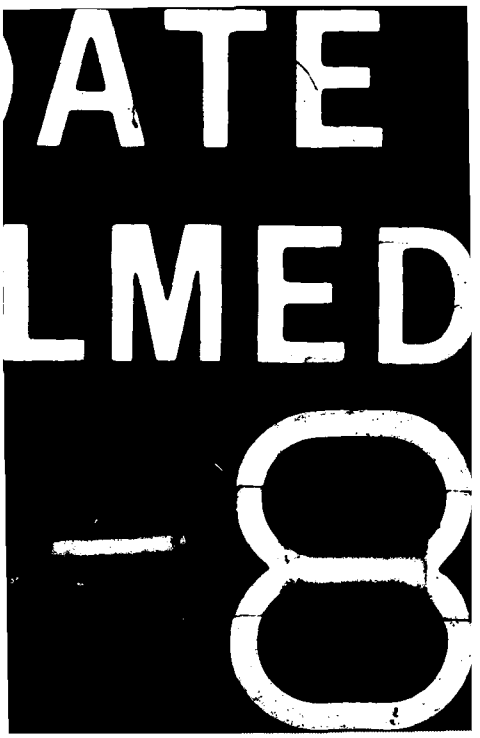
D-24

APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME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